# Report Documentation Page

| Report Date | Report Type | Dates Covered (from... to) |
|---|---|---|
| 00 APR 2001 | N/A | - |

| | |
|---|---|
| **Title and Subtitle**<br>Enlistment Supply in the 1990's: A Study of the Navy College Fund and Other Enlistment Incentive Programs | **Contract Number** |
| | **Grant Number** |
| | **Program Element Number** |
| **Author(s)** | **Project Number** |
| | **Task Number** |
| | **Work Unit Number** |
| **Performing Organization Name(s) and Address(es)**<br>Defense Manpower Data Center Joint Advertising & Market Research Division 1600 Wilson Blvd., Suite 400 Arlington, VA 22209-2593 | **Performing Organization Report Number** |
| **Sponsoring/Monitoring Agency Name(s) and Address(es)** | **Sponsor/Monitor's Acronym(s)** |
| | **Sponsor/Monitor's Report Number(s)** |
| **Distribution/Availability Statement**<br>Approved for public release, distribution unlimited | |
| **Supplementary Notes** | |
| **Abstract** | |
| **Subject Terms** | |
| **Report Classification**<br>unclassified | **Classification of this page**<br>unclassified |
| **Classification of Abstract**<br>unclassified | **Limitation of Abstract**<br>SAR |
| **Number of Pages**<br>114 | |

**DMDC Report No. 2000-015**
**April 2001**

# ENLISTMENT SUPPLY IN THE 1990'S: A STUDY OF THE NAVY COLLEGE FUND AND OTHER ENLISTMENT INCENTIVE PROGRAMS

**John T. Warner**
**Clemson University**

**Curtis J. Simon**
**Clemson University**

**Deborah M. Payne**
**Anderson College**

**with the research assistance of**
**J. Michael Jones**
**Graduate Student, Clemson University**

**Defense Manpower Data Center**
**Joint Advertising & Market Research Division**
**1600 Wilson Boulevard, Suite 400, Arlington, VA 22209-2593**

## Acknowledgements

The completion of this project would not have been possible without the help of many people who devoted substantial amounts of time to preparation of the data for this study and who provided assistance in their interpretation. First and foremost is our DMDC project officer, Dr. Robert Tinney, who oversaw the preparation of the various databases and devoted countless hours to the project. The completion of this project owes much to his ongoing advice and encouragement. Becky Tag at DMDC prepared the MEPCOM enlistment contract files. Don Bohn (Navy Recruiting Command) matched the MEPCOM records to Navy enlistment contract records to append information not available in the MEPCOM files. Steve Cylke (Bureau of Naval Personnel) and Lisa Springer (Naval Personnel Research and Development Center) provided historical information about the Navy enlistment bonus program. At the U. S. Army Recruiting Command, Claudia Beach, Kevin Lyman, and Teresa Monroe supplied Army enlistment contract data and information about the Army's college fund and enlistment bonus programs. Phoebe Wiener and Jeffery Rothenberg (PEP Research, Inc.) supplied advertising data. At DMDC, Sue Reinhold and Dr. Jerry Lehnus provided the YATS data. Finally, Dr. Tinney, Captain Gwen Rutherford (USAF), Dr. Sharon Holcombe (DMDC), and Elaine Sellman (DMDC) carefully reviewed the draft final report.

# ENLISTMENT SUPPLY IN THE 1990s: A STUDY OF THE NAVY COLLEGE FUND AND OTHER ENLISTMENT INCENTIVE PROGRAMS

## EXECUTIVE SUMMARY


### *Background*

Since the early 1980s the U. S. Army has used the Army College Fund (ACF) to attract high-quality recruits and channel them into hard-to-fill skills. Studies using 1980s data found the ACF to be a highly cost-effective means of attracting youth into service. Seeking to emulate the success of the Army's program, the U. S. Navy implemented its own Navy College Fund (NCF) program in 1990. Initially, the Navy's program was limited to 2,000 openings per year. Faced with mounting recruiting difficulties, the Navy expanded the NCF program dramatically in FY94 to 10,000 openings per year.

The Office of the Undersecretary of Defense for Personnel and Readiness [OUSD(P&R)] authorized this expansion and requested that the Defense Manpower Data Center (DMDC) support an evaluation study of the effectiveness of the new NCF program. This study was conducted for OUSD(P&R) by a research team at Clemson University at the request of DMDC. The objectives of this study were to provide answers to the following policy questions.

1. Did high-quality enlistments in the Navy increase as a result of expansion of the NCF?
2. Did expansion of the NCF lead to increased high-quality enlistments DoD wide, or were recruits merely diverted away from the other Services?
3. Did the NCF affect other recruiting outcomes crucial to the success of military recruiting such as attrition from the Delayed Entry Program (DEP)?
4. How cost-effective is the NCF compared with recruiters, advertising, and enlistment bonuses?

Since FY94, the Services have experienced increasing difficulty in accomplishing their recruiting missions. The critical policy question is what factors account for the challenges that confront military recruiting? The expansion of the civilian economy after the recession of 1992, evidenced by the largest decline in civilian unemployment in over 30 years, is an obvious factor. In addition, surveys indicate that young people are less interested in military service and more interested in attending college after completion of high school. They may also be receiving less encouragement to serve in the military because of a declining population of parents and other influencers who served in the military. The Services have responded to these recruiting challenges by increasing the numbers of recruiters, expanding advertising programs, and expanding the scope and size of enlistment incentive programs. How effective have these changes been at increasing high-quality enlistments?

Understanding the impact of changes in the economy, population, and recruiting programs on the supply of high-quality enlistments is needed to answer policy questions concerning the expansion of enlistment incentive programs since FY94, including the NCF

program. In principle, the results from earlier studies of military recruiting could be used to infer these effects. However, the role of some factors, particularly college attendance and the veteran population, was not examined in previous research. Moreover, certain enlistment outcomes (e.g., DEP attrition) were not studied at all. In addition, most previous research was conducted in the 1980s, and virtually no research has been done using data from the 1990s. This raises an important question. Are relationships estimated with data from the 1980s valid today? That is, would additional recruiting resources in today's recruiting environment have the same or a different impact than a decade ago? To address these issues, this study examined enlistment supply and other enlistment outcomes using recent data from the 1990s.

### *Study Tasks and Findings*

Three tasks were undertaken in this study. First, econometric models of high-quality enlistment supply were estimated with data from a 10-year period that begins prior to downsizing the U.S. military in the early 1990s and extends through 1997. Second, changes over time in youth propensity to enlist were analyzed to determine whether these trends provide information about future recruiting not captured by the analysis of enlistment supply. Third, the effects of enlistment incentives on other recruiting outcomes were evaluated using detailed information about incentive programs.

### *Enlistment Supply*

Data from DMDC, the Services, and a variety of other sources were assembled for the analysis of enlistment supply. Models of high-quality supply were estimated for the four Services (Army, Navy, Marine Corps and Air Force) using monthly and annual data by state for the period FY88-97. The models included the following variables:

1. labor market conditions measured by relative military pay and unemployment;
2. demographic factors such as college attendance and the racial composition of the 17-21 year-old population;
3. family background variables including average family income and the fraction of males aged 35 and older who were military veterans;
4. production recruiters and advertising expenditures;
5. enlistment incentive programs (in the Army and Navy models), including the college fund and enlistment bonus programs; and
6. cross-Service recruiting effects.

#### *High-quality Enlistment Supply*

***Army and Navy College Fund Benefits***. Both the ACF and NCF programs expand high-quality enlistments. To measure the size of these effects, the study findings have been used to estimate the impact of eliminating both programs. Army high-quality enlistments were about 48,000 in FY97. Fourteen thousand of these recruits received and accepted an ACF offer. The study findings imply that half of these recruits (i.e., 7,000) would not have enlisted in the absence of the ACF program. The impact of the NCF program was positive, but smaller. There were 32,000 Navy high-quality enlistments In FY97. Over nine thousand of these recruits

(9,200) received the NCF. The supply estimates indicate that about 1,600 (i.e., 17 percent) of these recruits would have not have joined the Navy in the absence of the program. A greater responsiveness of Army enlistments is to be expected given differences between the programs. For example, the average term of enlistment of ACF recipients was 3 to 3.5 years compared with 4 to 4.5 years for NCF recipients. The present value of college fund benefits was therefore higher for Army recruits than for Navy recruits.

***Enlistment Bonuses***. The findings indicate that doubling enlistment bonuses (EB) would increase Army high-quality enlistments by 12 percent. The estimate for the Navy was much smaller (3 percent) and statistically insignificant. The larger effects of Army bonuses may be due to the fact that many recruits who enlisted for 3- and 4-year terms in a wide range of Military Occupational Specialties (MOS) received EBs. The Navy on the other hand paid bonuses only to 5- and 6-year enlistments in a limited number of occupations (ratings). These findings suggest that the primary role of Navy bonuses has been to channel recruits into specific skills and longer terms of enlistment, rather than to expand market supply.

***Military Pay and Civilian Unemployment***. The research results imply that a 10 percent increase in military pay relative to civilian pay would increase high-quality enlistments between 4 percent and 12 percent. These estimates are well within the range of previous studies. Because military pay has kept pace with civilian wages over the past decade, recent recruiting difficulties cannot be attributed to a relative decline in military pay.

However, lower unemployment rates do explain some of the recent difficulty. The civilian unemployment rate is 50 percent lower than it was during the recession of 1992. The research findings show that each 10 percent decline in civilian unemployment results in a 2 percent to 3.5 percent reduction in high-quality enlistments. This suggests that if the FY97 unemployment rate had been at levels prevailing during the late 1980s, high-quality enlistments would have been higher by 11,000. More importantly, high-quality enlistments would have been higher by 22,000 in FY97 if the unemployment rate had been at its 1992 level.

***Recruiters and Advertising***. High-quality enlistments increase between 4 percent and 6 percent for each 10 percent increase in the number of Service recruiters in the field. These estimates are similar to those obtained in previous studies. Recruiter productivity differed, however, when the FY89-93 period was compared to FY94-97. Productivity of Navy, Air Force, and Marine Corps recruiters was higher in the latter period. However, recruiter productivity was lower for the Army during this same period. A 10 percent increase in the Army's recruiter force would have increased high-quality enlistment by only 4.1 percent in the FY93-97 period, compared with 5.5 percent in FY89-93. It is unclear from this study why the productivity of Army recruiters decreased while productivity increased in the other Services. This requires further study.

Advertising had a significant impact on high-quality Army and Navy enlistments. However, estimated effects are sensitive to whether advertising was measured in dollars or impressions. A 10 percent increase in total Army advertising impressions would increase high-quality enlistments by 14 percent; a 10 percent increase in total Navy advertising impressions would increase high-quality enlistment by 8 percent. The larger effect of Army advertising may

be due to the Army's larger advertising budget. The Army spends about four dollars on advertising to each dollar spent on Navy advertising.

There was no evidence that Marine Corps or Air Force advertising had positive effects on high-quality enlistments. This could be due to the small scale of their respective advertising programs. However, the advertising data for these Services were also incomplete and the quality of the data questionable. Conclusions about advertising effectiveness for these two Services are not possible under these circumstances. Evidence regarding the Joint-Service advertising program is mixed. Joint-Service advertising had a small, positive effect on high-quality enlistments for the Navy, Marine Corps, and Air Force. There was no measurable effect for the Army.

***College Attendance and Veteran Population Trends***. Two trends with adverse implications for military recruiting are an increase in college attendance and the decline of military service in the civilian influencer population. The fraction of 17-21 year-olds enrolled in college has risen by 11 percent since 1987. Model estimates indicate that this increase could account for an 11 percent reduction in high-quality enlistments DoD--wide by FY97, or about 14,300 enlistments at the 1997 recruiting level. The proportion of males 35 and older that were military veterans declined from 29 percent to 25 percent over the past decade. The estimates indicate that this could account for as much as a 15 percent reduction in Department of Defense (DoD) high-quality enlistments.

***Cross-Service Relationships***. An important policy issue is whether or not increases in programmed resources for one Service expand supply for all Services, or simply divert enlistments away from the others. Estimates of the effects of other Service recruiting efforts were negative for all four Services and statistically significant for the Army, Navy, and Marine Corps. The estimates imply that if all four Services attempted to expand high-quality enlistments by 10 percent (via more recruiters, advertising, etc.) the actual net increase in DoD enlistments would be 8.7 percent.

***Unexplained Trends in Recruiting and Propensity.*** Even after accounting for the effects of a host of economic and demographic factors, there remained a statistically significant negative trend in Army, Navy, and Air Force high-quality recruiting. These negative trends reflect the influence of time-related factors omitted from the model. One of the most important is youth propensity, which also declined over the study period and has a high degree of overlay with the omitted time effects. It appears that the negative trends in high-quality recruiting are a result of a decline in youth preference for military service.

### *Cost-Effectiveness of Pay, Recruiting Resources, and Incentive Programs*

The Services can expand high-quality supply by adding recruiters, expanding advertising programs, or offering better pay and enlistment incentives. Which policy options are most cost-effective? The enlistment supply model estimates provide data needed to calculate the cost of recruiting additional high-quality recruits, referred to hereafter as the marginal cost of each recruiting resource.

1. The marginal cost of basic pay exceeded $30,000 per person per year. Overall pay raises should be used to solve recruiting shortfalls only when there are generalized shortfalls in recruiting.

2. Enlistment bonuses expand supply for the Army, with an estimated marginal cost of $13,900 per additional enlistment.

3. Recruiters and advertising are more cost-effective policy options for increasing enlistments than pay or bonuses. The marginal cost of recruiters is $3,400 for the Air Force, $8,400 for the Navy, $9,500 for the Marine Corps and $12,500 for the Army. The marginal cost of additional advertising is less than $10,000 for the Army and Navy. The estimates also show that non-TV advertising was more cost-effective than TV advertising. However, this finding requires further research.

4. The estimate of marginal cost of the NCF is $12,800; the marginal cost of the ACF is much lower at $5,500. The NCF program is as cost-effective as recruiters and advertising for the Navy; the ACF is more cost-effective than recruiters and advertising for the Army.

## ***Propensity to Enlist***

The second study task was to evaluate the determinants of the propensity for military service using data from the *Youth Attitude Tracking Study* (*YATS*) and *Monitoring the Future* (*MTF*) *Survey*. The findings show that personal attributes and family background factors play a dominant role in determining propensity. Propensity to enlist is lower for high-quality youth, youth with better-educated parents, and youth planning to attend college. The analysis showed that the propensity to enlist increases with both relative military pay and unemployment. Despite strong statistical significance, the quantitative impact of changes in relative pay and unemployment were extremely small.

A large percentage of surveyed youth reported having talked with a military recruiter or having seen military advertising. However, propensity did not depend on recruiter density in the youth's state of residence at the time of the survey. Weak evidence was found that propensity responds to advertising. As in the case of relative pay and unemployment, the estimated impact of advertising was very small.

The recent decline in youths' propensity to enlist can be explained in part by factors including the decline in civilian unemployment, increased college attendance, and increases in parents' education. But these factors do not completely explain this decline. Other difficult-to-measure factors were at work during this period, including the end of the Cold War, downsizing, new and different military missions, and increased tempo of operations. Other data would be required to determine whether these factors played any role in the unexplained decline in propensity.

## *Other Recruiting Outcomes*

### *Attrition from the Delayed Entry Program*

Attrition from the Delayed Entry Program (DEP) has been increasing since 1992, currently averaging nearly 18 percent per year. This requires that the Services recruit 12 individuals for each 10 who actually access. A number of findings are presented, including the following.

1. The most important determinant of DEP attrition is the time in DEP provision of the enlistment contract. Each month of contracted time in DEP raises the probability of DEP attrition by 2.5 percent. Thus, an increase in time in DEP from 4 months (the sample average) to 8 months increases the probability of DEP attrition by 10 percent.

2. The most important personal attribute affecting DEP attrition is gender. Women are 7 percent more likely to leave DEP than men – two-fifths of the average loss rate of 18 percent.

3. DEP attrition was lower among those who sign contracts for longer terms of enlistment, perhaps indicating higher propensities for military careers.

4. DEP attrition falls as unemployment rises.

5. DEP attrition was lower among recipients of enlistment incentives (EB, ACF or NCF).

6. There remained a rise in DEP attrition over the study period that could not be explained by the variables in the model. A number of factors might account for this rise, including reduced monitoring of recruits in DEP and increased Service efforts to screen recruits for drug use. Identifying the exact cause requires further analysis.

### *Other Choices*

***Enlistment Term***. The relative level of enlistment incentives offered for alternative enlistment options affected recruits' enlistment term and skill choices. Research results show that greater monetary values of the ACF, NCF, or EB offered at longer enlistment terms lead recruits to enlist for longer periods of time.

***Choice of Military Skill***. Recruits' skill choices are sensitive to the coverage and value of benefits of the ACF, NCF, and EB programs. When an Army MOS becomes eligible for the ACF, enlistments for that MOS increase 35 percent. When a MOS becomes eligible for an Army EB, enlistments for that MOS increase 25 percent.

***Choice of Enlistment Incentive***. Some Army and Navy skills offered recruits the option of either an EB or college fund (during the study period recruits were not eligible to receive both incentives). In such skills, half of recruits of both Services selected an EB, and the

other half opted for the college fund. Choice of incentive is sensitive to the value of an EB relative to the value of a college fund offer. For example, based on average bonuses in the Army and Navy respectively in FY97, the findings imply that doubling the size of enlistment bonuses would increase the proportion choosing EBs by 10 percent (one fourth) in the Army and 15 percent (one-third) in the Navy. Choice of enlistment incentive also depends on schooling status, race, gender, and term of service. Recruits in school at the time of a contract are more likely to select the college fund as are Whites, Hispanics, and females. Recruits who elect longer terms of service are more likely to select a bonus.

## *Conclusion*

Military pay, civilian unemployment, the size of the recruiter force, and Service advertising were all estimated to have effects on high-quality enlistment that are consistent with estimates from a host of previous studies. The results also indicated that enlistment incentives expand high-quality enlistment. In addition, such incentives help channel recruits into hard-to-fill occupations and longer terms of enlistment. Other factors were found to have a significant impact on high-quality enlistment. Some of these, most notably the rise in college attendance and the decline in the size of the veteran population, explain part of the decline in high-quality enlistments during the 1990s. But after accounting for these factors, there remains an unexplained decline in high-quality enlistments that appears to be related to a drop in youth propensity. This drop in youth propensity, although related to economic and demographic trends, remains largely unexplained.

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# CHAPTER 1

# INTRODUCTION

### *Background*

Since the early 1980's the U. S. Army has used the Army College Fund (ACF) to attract high-quality recruits and channel them into hard-to-fill skills. Studies using data from the 1980s found the ACF to be a highly cost-effective means of attracting youth into service. Seeking to emulate the success of the Army's program, the U. S. Navy implemented its own Navy College Fund (NCF) program in 1990. Initially, the Navy's program was limited to 2,000 openings per year. Facing mounting recruiting difficulties, the Navy expanded the NCF program dramatically in FY 1994 to 10,000 openings per year.

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2. Did expansion of the NCF lead to increased high-quality enlistments DoD wide, or were recruits merely diverted away from the other Services?
3. Did the NCF affect other recruiting outcomes crucial to the success of military recruiting such as attrition from the Delayed Entry Program (DEP)?
4. How cost-effective is the NCF compared with recruiters, advertising, and enlistment bonuses?

Since 1994, the Services have experienced increasing difficulty in accomplishing their recruiting missions. The critical policy issue is to determine what factors have made military recruiting increasingly difficult since the mid-1990s. The expansion of the civilian economy after the recession of 1992, evidenced by the largest decline in civilian unemployment in over 30 years, is one obvious factor. In addition, however, surveys indicate that young people are less interested in military service and more interested in attending college after completion of high school. They also may be receiving less encouragement to serve in the military because of a declining population of parents and other influencers who served in the military. The Services have responded to these recruiting challenges by increasing the numbers of recruiters, expanding advertising programs, and expanding the scope and size of enlistment incentive programs. How effective have these changes been at increasing high-quality enlistments?

Understanding the impact of changes in the economy, population, and recruiting programs on the supply of high-quality enlistments is needed to answer policy questions concerning the expansion of enlistment incentive programs since FY94, including the NCF program. In principle, the results from earlier studies of military recruiting could be used to infer these effects. However, the role of some factors, particularly college attendance and the veteran population, was not examined in previous research. Moreover, certain enlistment outcomes (e.g.,

DEP attrition) were not studied at all. In addition, most previous research was conducted using data from the 1980s. Relatively little research exists using data from the 1990s. This would not pose a problem if enlistment supply relationships estimated in earlier research were valid in today's' recruiting environment. In other words, would additional recruiting resources in today's recruiting environment have the same or a different impact than a decade ago? To address these issues, this study examined enlistment supply and other enlistment outcomes using recent data from the 1990s.

### *Study Tasks and Organization of the Report*

Three tasks were undertaken in this study. First, econometric models of high-quality enlistment supply were estimated with data that begins prior to the period of downsizing of the U.S. military (1987) and extends through 1997. Second, changes over time in youth propensity to enlist were analyzed to determine whether these trends provide information about future recruiting not captured by the analysis of enlistment supply. The discussion focuses in particular on explaining the downward trend in youth propensity for military service observed in recent years. Third, the effects of enlistment incentives on other recruiting outcomes were also evaluated using detailed information about incentive programs. The data used for the study are described in Chapter 2. Chapter 3 contains the propensity analysis. Chapter 4 describes the enlistment supply analysis and is divided into two sections. The first section focuses on econometric methodology and data issues. The second section describes the findings and their implications for policy decisions. Analyses of other recruiting outcomes are discussed in Chapters 5-7. Previous research is reviewed in detail in Appendix B.

# CHAPTER 2

# DATA OVERVIEW

## *Data Sources*

Data for the enlistment supply analysis were provided by a number of sources. The Defense Manpower Data Center (DMDC) constructed a file containing information about each enlistment contract that the Services reported to the Military Entrance Processing Command (MEPCOM) between FY87 and FY97. These MEPCOM contract records contain demographic information about each recruit but lack several key data elements that were necessary for this analysis. Marine Corps Enlistment Bonus (EB) and Marine Corps College Fund (MCCF) recipients could be identified with available MEPCOM data.[1] However, it was impossible to determine whether Army recruits received an EB or the Army College Fund (ACF) from MEPCOM records. Navy College Fund (NCF) recipients could be identified for the years FY1990-94, but not thereafter. Navy bonus recipients could not be identified in any year. Virtually no Air Force recruits received an enlistment incentive during the period of study.

An additional data problem arose concerning the Army. Historically, one category of recruits has entered the active Army by first enlisting in the Army Reserve and then changing to active duty status within 180 days. Because these recruits do not enter the military through a MEPS, they are not included in the MEPCOM active duty enlistment database. Consequently, relying solely on MEPCOM data for the Army understates the size of active Army enlistment production. Therefore, Army data were used for analyses of Army outcomes. All enlistment contracts of the other Services are in the MEPCOM database, which was, therefore, used for the analysis of the other three Services.

Army enlistment contract records were obtained from the Army's Minimaster file and Enhanced Accession File (EAF). The Minimaster database contains all Army enlistment contracts written between October 1986 and June 1996. The EAF includes contract records from June 1993 through the present. The Minimaster and EAF files indicate whether or not recruits received either an EB or the ACF. The Army supplemented these contract files with an electronic database that provided eligibility, coverage, and benefits information for the EB and ACF programs during the study period.[2]

The Navy Recruiting Command provided Navy incentive data by matching Social Security numbers on Navy contract records in the MEPCOM database and on records in the

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[1] The Services report information about each enlistment to MEPCOM using a 5-digit alphanumeric variable called Program Enlisted For (PEF). Each Service has a different coding system for the PEF variable. In principle, receipt of NCF can be identified from the Navy's PEF codes. The PEF code uniquely identifies NCF recipients prior to FY95. Beginning in FY95 however, the Navy coding for receipt of NCF conflicted with the coding used to identify enlistees who entered nuclear fields (so-called "Nukes"), making it necessary to use other data sources. The Navy never used PEF to identify EB recipients, nor did they consistently identify bonus recipients using the bonus field available in the MEPCOM scheme. The Marine Corps coding system permitted identification of EB or MCCF recipients. Army and Air Force PEF codes contain no information about receipt of an enlistment incentive.

[2] Minimaster data were used prior to FY 1994 and EAF data were used from FY 1994 onward. Although this combined file contains a larger number of contracts than do the MEPCOM files, time-series graphs of the aggregate contract numbers from the two sources revealed that they tracked one another closely over time.

Navy's TrainTrack enlistment database, maintained at Navy Personnel Research, Studies, & Technology (NPRST), formerly the Naval Personnel Research Development Center (NPRDC).[3] Data elements in the Navy file indicated whether or not recruits actually received an EB or the NCF incentive. This information was appended to MEPCOM records when a match occurred. To complete analyses of Navy EBs, data were needed that identified skills (i.e., ratings) eligible for EBs and the dollar amount of bonuses.[4] The information on bonus eligibility was taken from policy guidance memoranda obtained from the Navy Recruiting Command (CNRC).

Data on production recruiters and advertising were supplied by the Services and DMDC respectively. Each Service provided monthly data to DMDC on the number of production recruiters for the period FY87-97. These data were submitted according to geographic boundaries of Service recruiting districts (i.e., structure of Service Recruiting Commands). Contract goals were also required for the analysis and the Services provided monthly observations of these data elements along with their recruiter submissions. DMDC mapped each Services' recruiting districts to 3140 counties in the 48 contiguous states and provided a data file containing recruiters and goals by Service, county, and month for the period FY87-97.

P.E.P. Research, Inc., a contractor to DMDC, provided advertising data used in the study. The Service advertising agencies provided source data for the P.E.P. database. The database developed by P.E.P. included advertising expenditures and impressions by national and local advertising medium (e.g., network and cable television, print), month, year, and county for each Service and the Joint Advertising program. Specifically, it included:

1. Army advertising data for all media for FY88 through FY97;
2. Navy and Joint-Service advertising data for all media from FY87 through FY97 (however, Navy local advertising data is annual rather than monthly and its quality unknown);
3. Marine Corps advertising data on national TV expenditures and impressions for FY88-97;
4. Air Force data on newspaper and direct mail advertising for FY87-97; no data were provided for local media.

Other data requirements included population, labor force data and youth earnings. DMDC provided population estimates by age, race/ethnicity, gender, educational attainment, and county for calendar years 1987-99. Variables created for the analysis include the size of the 17-21-year-old population by gender, race/ethnicity, education attainment, county and state. Educational attainment is defined by categories for high school seniors, high school graduates, college students, and college graduates. In addition to population estimates for each of these groups, the percentage of the 17-21-year-old population enrolled in college each year by state was also tabulated.[5]

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[3] The Social Security numbers are confidential, and hence were removed from the matched file before being sent to the Clemson research team.
[4] The Navy appended other information not contained in the MEPCOM records. For example, MEPCOM records for Navy enlistees often do not contain the length of the active duty enlistment but rather the length of active duty enlistment plus reserve obligation. Navy data permitted identification of actual length of active duty commitment.
[5] The proportion "in college" includes college graduates, but the contribution of college graduates is very small since most youth have not completed college by age 21.

Earnings data were obtained from micro data sub samples of the monthly Current Population Surveys (CPS). These Surveys are nationally representative samples of the population. The wage data together with Department of Defense (DoD) pay tables were used to calculate monthly estimates of relative military pay by state and Census Division. Finally, the Local Area Unemployment Statistics (LAUS) database tabulated by the Bureau of Labor Statistics (BLS) was the source of unemployment data. Estimates of the employed and unemployed populations by county and month were used to compute unemployment rates for states and Census Divisions.

### *Trends in Enlistments*

Table 2.1 displays the number of total and high quality (HQ) gross enlistment contracts by fiscal year for the period FY 87-97. High-quality recruits are defined as high school graduates who score 50 or better on the Armed Forces Qualification Test (AFQT). Gross contracts include contracts for recruits who enter military service as well as contracts for recruits who entered the Delayed Entry Program (DEP) but left within 12 months of the date of the contract (that is, who "attrited" from DEP). Table 2.1 shows Army gross contract counts for the Army and MEPCOM (MEP) databases respectively. The number of contracts for the other Services shows gross contract counts from the MEPCOM database.

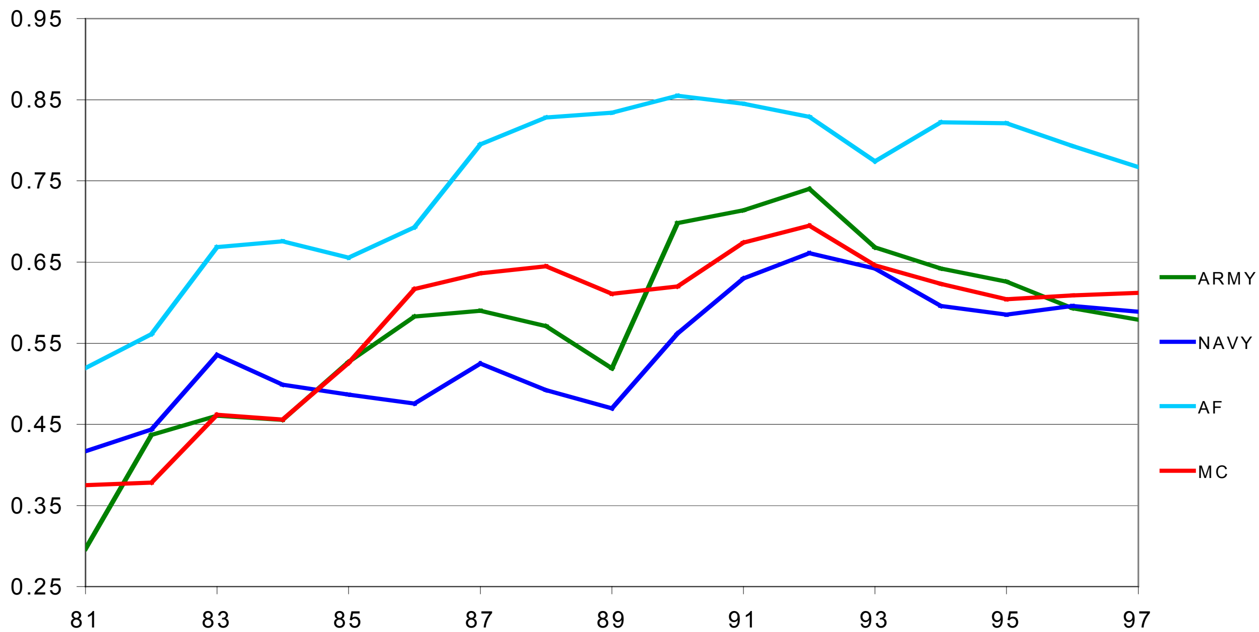
**Table 2.1**
***Enlistment Contracts by Fiscal Year***

| | *Army* | | | | *Navy* | | *Air Force* | | *Marine Corps* | |
|---|---|---|---|---|---|---|---|---|---|---|
| *FY* | *Total (Army)* | *HQ (Army)* | *Total (MEP)* | *HQ (MEP)* | *Total (MEP)* | *HQ (MEP)* | *Total (MEP)* | *HQ (MEP)* | *Total (MEP)* | *HQ (MEP)* |
| 87 | 123592 | 70957 | 127585 | 75013 | 104317 | 54558 | 60032 | 47634 | 44086 | 28007 |
| 88 | 112302 | 65051 | 107702 | 61239 | 95342 | 46654 | 44720 | 36954 | 38364 | 24651 |
| 89 | 119535 | 62874 | 121522 | 62824 | 96119 | 44978 | 46514 | 38700 | 39205 | 23829 |
| 90 | 98754 | 69773 | 96960 | 67566 | 91614 | 51310 | 33844 | 28855 | 43372 | 26776 |
| 91 | 85367 | 61421 | 83375 | 59385 | 79034 | 49599 | 35444 | 29854 | 39138 | 26316 |
| 92 | 75380 | 56327 | 72114 | 53226 | 73880 | 48629 | 38126 | 31440 | 37409 | 25976 |
| 93 | 80388 | 54528 | 77182 | 51336 | 63919 | 40843 | 36159 | 27823 | 41003 | 26385 |
| 94 | 71875 | 47043 | 67841 | 43299 | 59551 | 35337 | 33372 | 27273 | 41052 | 25462 |
| 95 | 75440 | 48377 | 72763 | 45269 | 57630 | 33546 | 34655 | 28270 | 40849 | 24576 |
| 96 | 80536 | 48991 | 79363 | 46735 | 57798 | 34127 | 36763 | 28978 | 42794 | 25958 |
| 97 | 82405 | 48783 | 84570 | 48428 | 55228 | 32222 | 35865 | 27281 | 43831 | 26705 |

The data reveal a substantial decline in enlistment in the Army, Navy, and Air Force over the FY87-97 period. Army contracts fell by one-third, Air Force contracts by two-fifths and Navy contracts by one-half. These declines were largely a result of the reduction in recruiting missions that accompanied military downsizing. Marine Corps production was stable, reflecting a recruiting mission that changed little over the period.

Table 2.1 shows that the decline in recruiting missions enabled the Services to focus on high-quality recruiting. High-quality contracts as a fraction of total contracts from FY81 to FY97 are displayed in Figure 2.1. The data for FY87-97 are from Table 2.1; the proportions for FY81-FY86 are from MEPCOM data analyzed in Warner (1990). The proportion of high-quality recruits for the Navy increased significantly during the period of downsizing (FY89-92). Similar increases in percent high-quality occurred for the Army and Marine Corps in FY89-92. Since FY93, however, percent high-quality has declined, and reflects an increasingly difficult recruiting environment.

**Figure 2.1**
***High-Quality Contracts as a Fraction of Total Contracts, FY81-97***

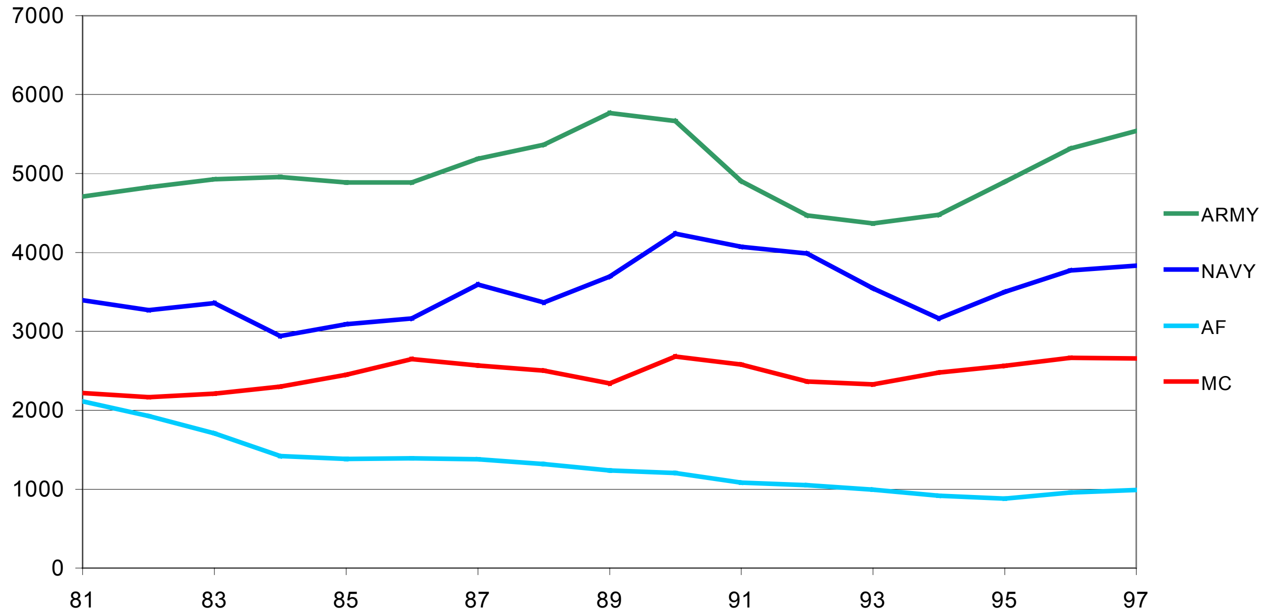



### *Trends in Recruiting Resources*

#### *Production Recruiters*

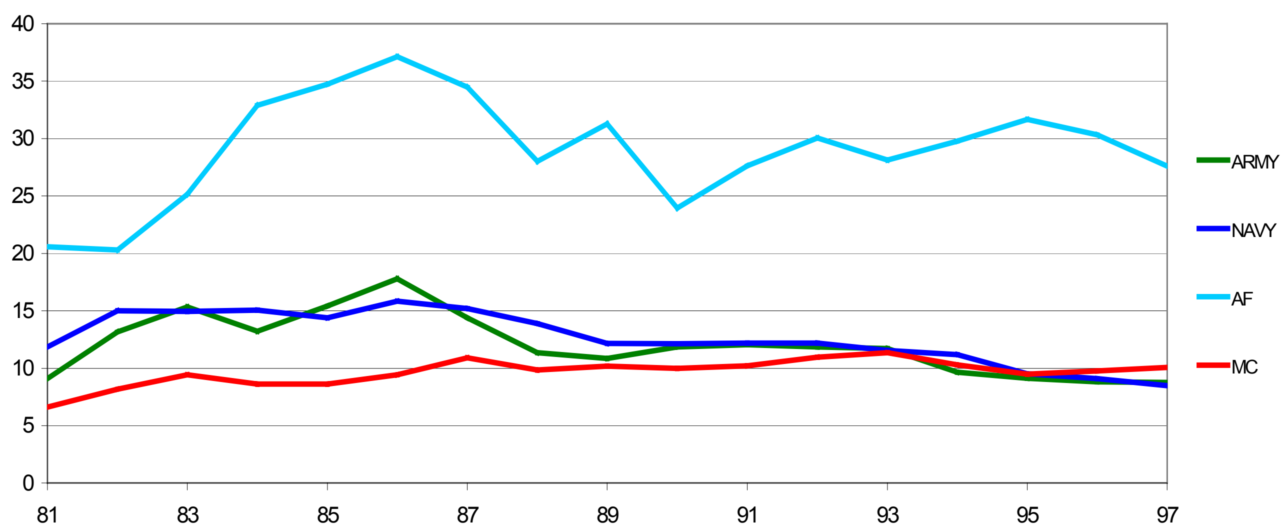
Figure 2.2 shows trends in the number of production recruiters for the Services. Three distinct regimes are visible in the case of the Army and Navy: the force buildup in the 1980s, the drawdown of the early 1990s, and force sustainment since FY94. On the other hand, the number of Air Force recruiters fell steadily during this period, while Marine Corps recruiters, after rising between FY81 and FY86, have held relatively flat since then.

**Figure 2.2**
***Production Recruiters, FY 81-97***




To examine trends in recruiter productivity, Figure 2.3 graphs the number of high-quality contracts signed per production recruiter. Recruiter productivity fluctuated over the 16-year period. After rising in the early 1980s, recruiter productivity began to decline shortly thereafter in three of the four Services (the Marine Corps was the exception.) After leveling out in the early and mid-1990s, recruiter productivity began to fall again in FY 1995 in the Army, Navy, and Air Force.

**Figure 2.3**
***High-Quality Contracts Per Recruiter, FY 81-97***



Compared to earlier years, productivity in the Army was roughly at its FY81 level in FY95, and fell below that in the subsequent two fiscal years. Navy productivity fell below its FY81 level in FY93, and continued to decline through FY97.

### *Advertising*

Table 2.2 shows total advertising expenditures by Service and the fraction of advertising devoted to television (TV). A number of patterns emerge from the data in Table 2.2. First, it shows that Service advertising expenditures have followed a pattern much like that of recruiters that reflects the changing mission requirements the force buildup of the 1980s, downsizing in the early 1990s, and the sustainment period since the mid-1990s. It shows that Navy advertising is on a much smaller scale than Army advertising, while the Marine Corps and Air Force programs are smaller still than the Navy's.[6] Finally, the data show that Joint-Service advertising expenditures were extremely volatile, falling from a high of $18.8 million in FY88 to a low of $1.5 million dollars six years later (FY94).

**Table 2.2**
***Service Advertising (in Millions) and TV Advertising as a Fraction of Total Advertising***

| | *Army* | | *Navy* | | *Air Force* | *Marines* | *Joint* | |
|---|---|---|---|---|---|---|---|---|
| **FY** | ***Total $*** | ***TV Share*** | ***Total $*** | ***TV Share*** | ***Total $**** | ***Total $***** | ***Total $*** | ***TV Share*** |
| 87 | | | 12.7 | 0.822 | 0.1 | | 14.3 | 0.927 |
| 88 | 54.3 | 0.512 | 6.6 | 0.757 | 0.3 | 0.3 | 18.8 | 0.985 |
| 89 | 50.3 | 0.490 | 6.9 | 0.173 | 2.5 | 2.7 | 21.2 | 0.988 |
| 90 | 61.5 | 0.437 | 12.6 | 0.704 | 2.2 | 3.7 | 12.2 | 0.723 |
| 91 | 38.4 | 0.440 | 8.7 | 0.437 | 1.7 | 4.3 | 6.6 | 0.000 |
| 92 | 45.6 | 0.413 | 4.9 | 0.000 | 0.6 | 2.9 | 9.8 | 0.000 |
| 93 | 26.9 | 0.464 | 4.1 | 0.072 | 1.1 | 4.0 | 3.2 | 0.000 |
| 94 | 35.7 | 0.438 | 10.5 | 0.424 | 2.1 | 3.2 | 1.5 | 0.000 |
| 95 | 49.2 | 0.498 | 19.6 | 0.650 | 2.5 | 3.6 | 13.0 | 0.615 |
| 96 | 51.7 | 0.514 | 21.1 | 0.641 | 4.2 | 3.9 | 10.2 | 0.734 |
| 97 | 70.1 | 0.612 | 18.8 | 0.623 | 2.9 | 9.1 | 1.2 | 0.000 |

*No TV advertising.
**All TV advertising.

Advertising expenditures may not accurately measure the "real" outcome of an advertising program or campaign in the sense of measuring how many viewers in given target audiences were reached. A more accurate measure of advertising in this sense is advertising impressions–the number of individuals in a target audience reached by a given amount of advertising expenditures. Impressions will deviate from expenditures if either the unit price of advertising or the habits of the target audience change. TV impressions, for instance, might fall despite increased advertising outlays if the unit cost of TV ads increases or if fewer individuals

[6] Recall from earlier discussion of the data that Air Force expenditures are for newspapers and direct mail only and do not include local advertising, and that Marine Corps expenditures are for national TV only.

watch TV. Trends in TV impressions per dollar of TV advertising and non-TV impressions per dollar of non-TV advertising are displayed in Figures 2.4 and 2.5.

Figure 2.4 shows that impressions per dollar of Army advertising fluctuated between 16 and 26 over the last decade, but no consistent trend emerged. Navy TV impressions per dollar must be interpreted with caution. The Navy spent no money on TV advertising in FY92 (hence the zero figure for that year) and spent only $295,000 in FY93. Navy TV impressions per dollar are more similar to Army impressions per dollar in other years.

Comparing Figures 2.4 and 2.5, it can be seen that non-TV advertising generates a much larger number of impressions per dollar than TV advertising. This does not, however, indicate that TV advertising is less cost-effective than other media, for two reasons. First, impressions per dollar measure the average productivity of advertising. However, cost-effectiveness is a function of marginal productivity rather than average productivity. Second, impressions from the various media are not necessarily equally productive in generating interest in the military. It could be the case, for example, that a TV impression is more likely to produce a recruit than a radio impression. The empirical analysis in Chapter 4 attempts to shed light on the cost-effectiveness of these alternative media.

**Figure 2.4**
***Impressions Per Dollar of TV Advertising***

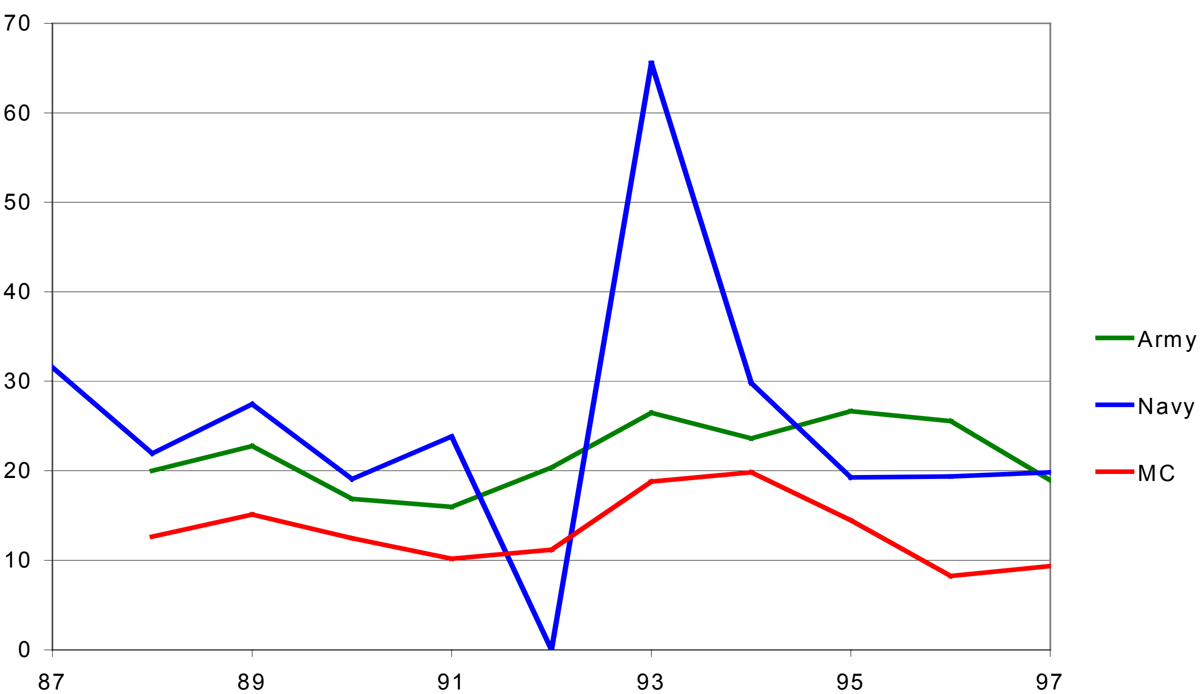
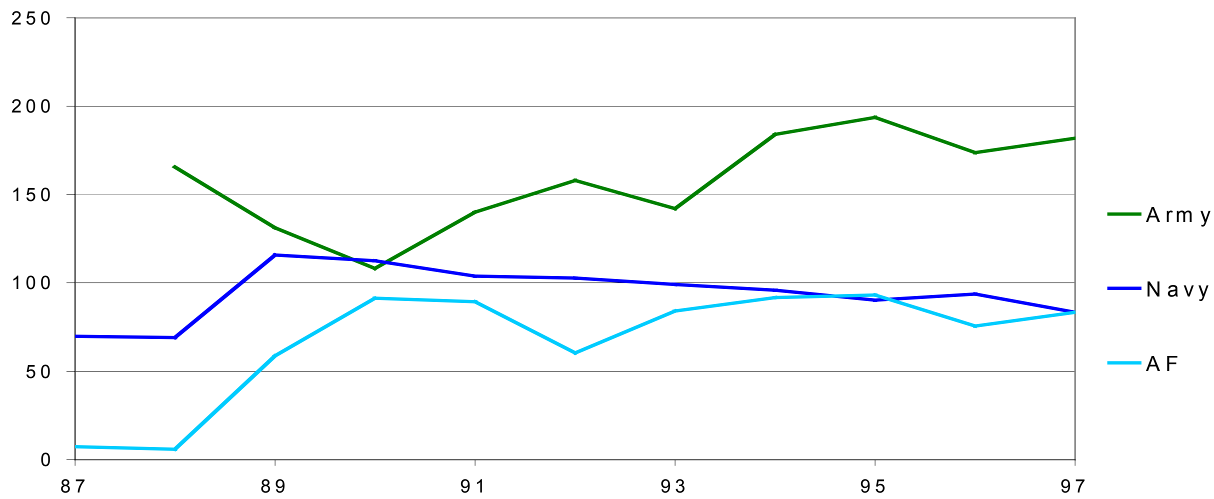


**Figure 2.5**
***Impressions Per Dollar of non-TV Advertising***




***Cost Per Contract of Recruiters and Advertising in FY97.*** Table 2.3 shows how the Services allocated resources between recruiters and advertising on a per-contract basis for FY97. For the purpose of these comparisons, recruiters are priced at $45,000 each. Costs are shown for total contracts and for high-quality contracts, and figures have been rounded to the nearest $50. In FY97, each enlistment contract cost the Army about $3,050 worth of recruiters and $850 worth of advertising, for a subtotal of $3,900. The cost per Navy contract was lower because the Navy spent less on advertising. The Air Force had the lowest cost due to its much higher recruiter productivity (see Figure 2.3 above).

Table 2.3 shows that recruiters account, by far, for the greatest share of resources allocated to recruiting. Even after a large increase in advertising outlays in FY97, the Army was spending almost four times as much on recruiters as on advertising. Similarly, the Navy, Air Force and Marine Corps spent nearly 10 times as much on recruiters as on advertising. The empirical analysis in Chapter 4 provides some evidence about the efficiency of the current allocation of resources between recruiters and advertising

**Table 2.3**
***Cost Per Contract of Recruiters and Advertising in FY 97***

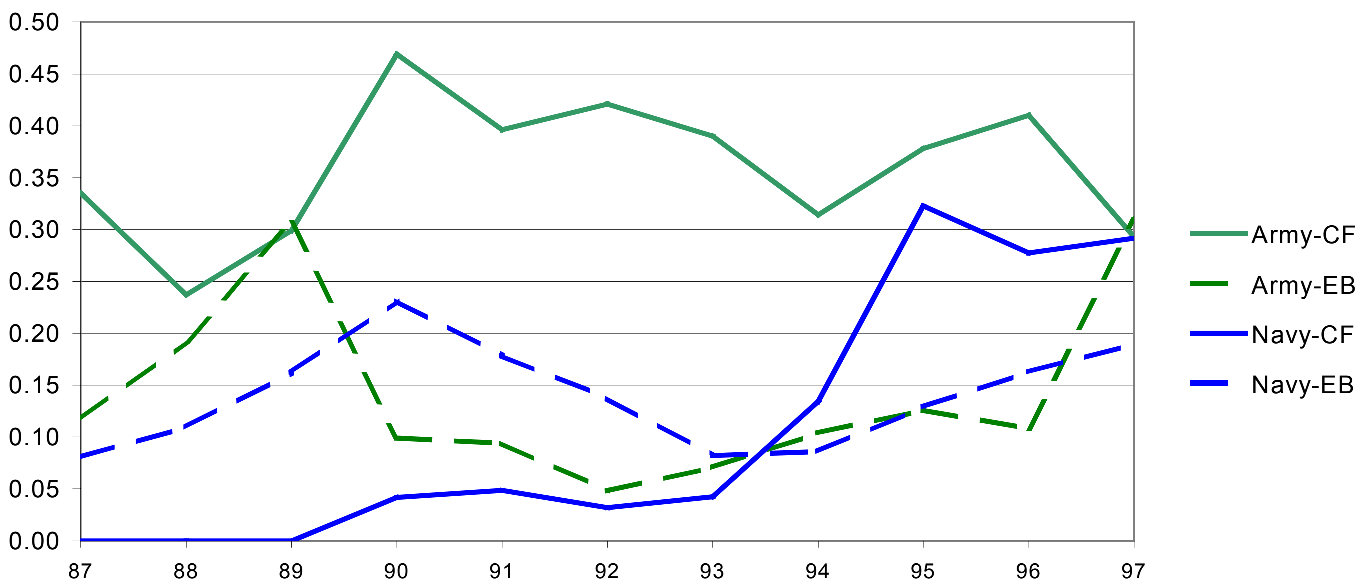
| ***Contracts*** | ***Army*** | ***Navy*** | ***Air Force*** | ***Marine Corps*** |
|---|---|---|---|---|
| | | ***Recruiters*** | | |
| Total | $3,050 | $3,100 | $1,200 | $2,800 |
| High-Quality | $5,100 | $5,350 | $1,650 | $4,500 |
| | | ***Advertising*** | | |
| Total | $850 | $350 | $80 | $200 |
| High-Quality | $1,450 | $600 | $100 | $350 |

### *College Fund Programs*

This study focuses on the effects of college benefits and enlistment bonuses in the Army and Navy. In the Marine Corps, fewer than 10 percent of enlistees received enlistment bonuses each year, and only 5 percent per year have ever received the Marine Corps College Fund (MCCF) since its inception in FY93. The Air Force had a very small enlistment bonus program and no college fund incentive. Because the incentive programs in the Marine Corps and Air Force were relatively small over the time period studied here, it was not feasible to obtain precise estimates of their effects.

Figure 2.6 shows the proportion of high-quality enlistments in the Army and Navy that received the ACF, NCF or an EB incentive. After rising in the late 1980s, the proportion receiving the ACF fell during downsizing, and began to increase again as recruiting became more difficult in the middle and late 1990s.

**Figure 2.6**
***Fraction of Army and Navy High-Quality Recruits Receiving CF and EB***



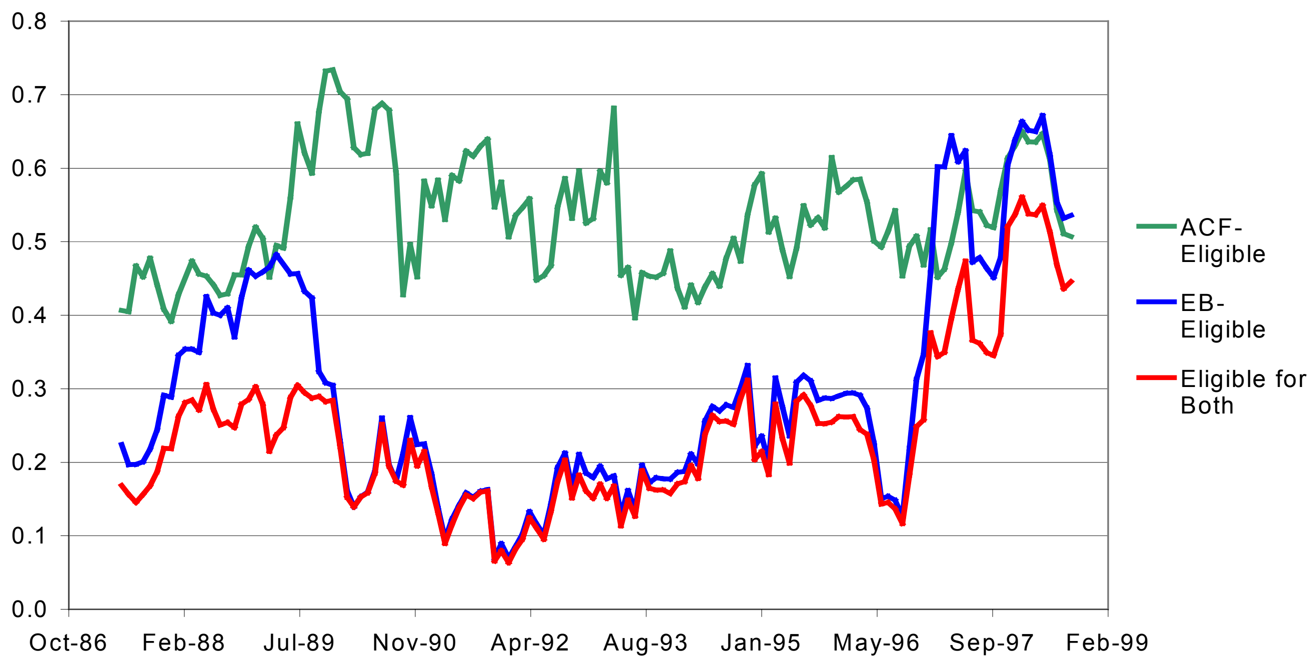

Army EB coverage was also reduced during downsizing, reaching a nadir in FY92, a year in which only 5 percent of high-quality enlistees received an EB. Military Occupation Specialty (MOS) eligibility and EB coverage increased dramatically after FY96, reaching nearly 37 percent by FY98. The percentage of Navy high- quality enlistees receiving an EB followed a pattern similar to that of the Army. Historically, the Navy has awarded EBs only to recruits who serve for 5 or 6 years on active duty. This contrasts sharply with the Army, which awards EBs to recruits who sign for as little as three years of service.

Figure 2.7 provides additional detail regarding eligibility for enlistment incentives in the Army. The green line shows the percent of high-quality recruits eligible for ACF by month; the blue line shows percent eligible for an EB; and the red line shows the percent eligible for both ACF and EB (they could choose only one incentive prior to FY99). Notice that eligibility for

Army EB increased dramatically beginning around the Summer of 1996. This probably accounts for the fall in ACF receipts in FY96-97 (see Figure 2.6 above).

Figure 2.8 shows the percentage of high-quality Army recruits receiving the ACF by term of enlistment. Recruits who enlist for a two-year term of enlistment (2YO) are not eligible for EB. However, ACF is clearly a highly valued incentive for this group, and was received by nearly all 2YO recruits in FY97. Relatively few 5YO and 6YO recruits chose the ACF. These figures suggest that recruits who are interested in obtaining a college education are more likely to enlist for shorter terms of service.

**Figure 2.7**
***Army ACF and Bonus Eligibility***




The Navy College Fund (NCF) began as a small pilot program in FY90 with about 2,000 openings per year. Initially, fewer than 5 percent of Navy high-quality recruits received the NCF incentive. However, the NCF expanded to 4,700 openings in FY94 and 10,800 in FY95. Between FY95 and FY97, 30 percent of the Navy's high-quality recruits received the NCF. The NCF has been reserved for longer terms of service than the ACF. Figure 2.9 demonstrates that the NCF has been used primarily for 4YO enlistments since FY90, and 5YO and 6YO recruits since FY94. Although substantial numbers of 3YO recruits (65 percent) received the NCF in 1995, the Navy has phased out eligibility for this term of service category

To place a dollar value of educational benefits, this study uses the expected present value of college benefits provided by each Service. All recruits are eligible to participate in the Montgomery GI Bill (MGIB) college benefits program, which requires them to pay $1,200 in their first year ($100 per month) in return for college benefits that vary with the term of enlistment. In addition to the MGIB, the Army and Navy offer recruits in selected skills

additional college benefits, called "kickers." These kickers vary by term of enlistment (YO) and skill category -- Army MOS and Navy Rating.

**Figure 2.8**
***Fraction of Army High-Quality Recruits Receiving ACF By Term***

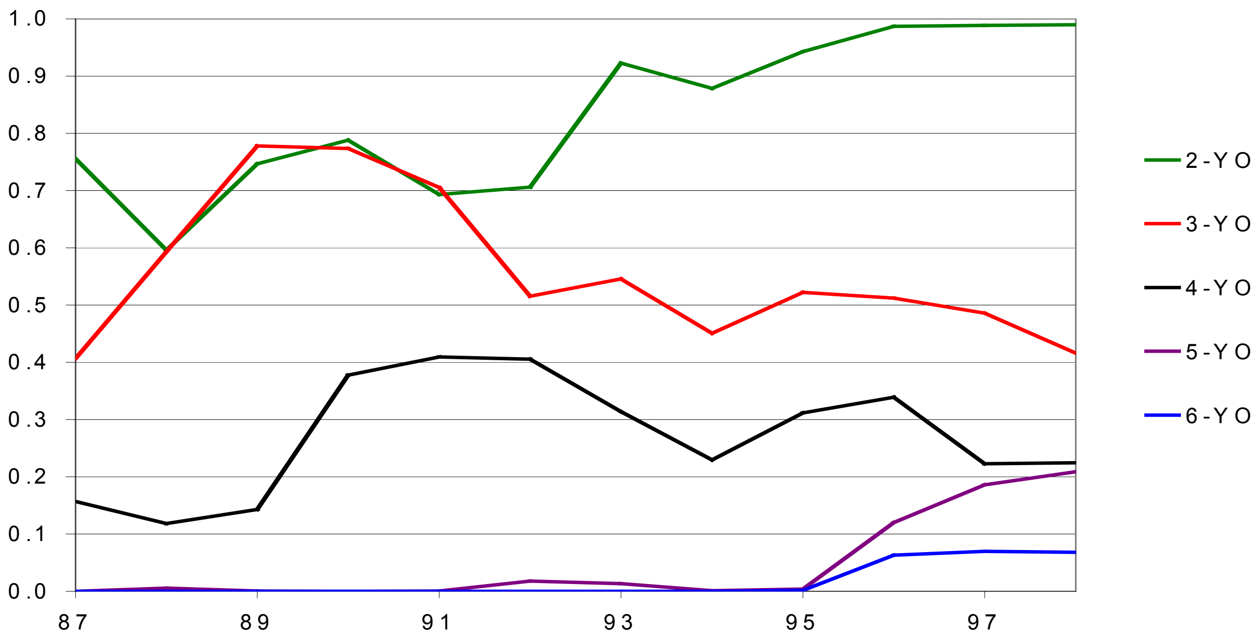
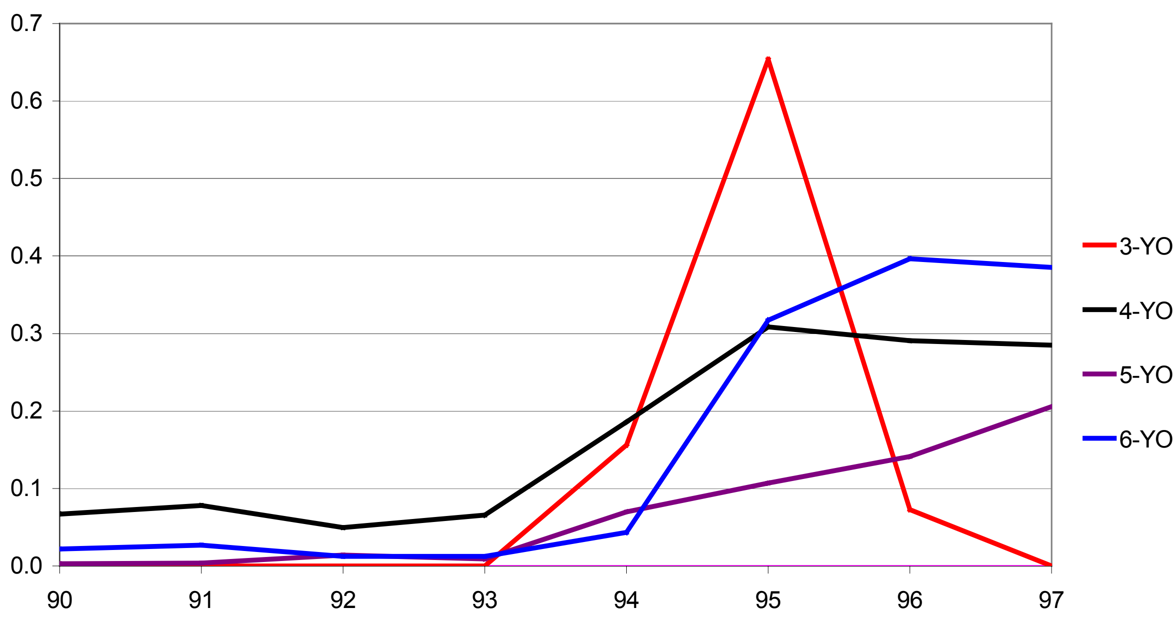



**Figure 2.9**
***Fraction of Navy High-Quality Recruits Receiving NCF By Term***



The expected value of the college benefits for Army and Navy recruits is computed based on eligibility for the ACF or NCF programs. Let $MGIB_{yt}$ denote the nominal value of the college benefits paid under the Montgomery GI Bill for a recruit who enlists for $y$ years of service. Let $CF_{yt}$ denote the corresponding value of the ACF or NCF respectively. The nominal value of potential college benefits for a recruit who enlists in skill $s$ for $y$ years of service at time $t$ is $C^s_{yt} = \max[MGIB_{yt}, \delta_{st} ACF_{yt}]$, where $\delta_{st}$ is a variable that can be 1 or 0 (known as a dummy variable). The value of this dummy variable was equal to 1 for Army recruits if they were eligible for the ACF, and 1 for Navy recruits who actually received the NCF incentive.[7] To compute present values, we assume that $C^s_{yt}$ is received in equal installments for four years immediately following initial enlistments. The nominal value of benefits is deflated by the tuition component of the Consumer Price Index (CPI). A discount rate of 10 percent is used to calculate present values.[8] With these assumptions, the present value of college benefits for the average recruit is given by the following equation:

$$PVC^M_{yt} = [C^M_{yt}/4]\,[1/(CPI_{t+y})(1.1)^{t+y} + 1/(CPI_{t+1+y})(1.1)^{t+1+y} + 1/(CPI_{t+2+y})(1.1)^{t+2+y} + 1/(CPI_{t+3+y})(1.1)^{t+3+y}].$$

The expected present value of college benefits at time t, $PVCOL_t$, is calculated as the sample mean of $PVC^M_{yt}$ across recruits at each point (month) in time.[9]

Figure 2.10 shows the expected present values of Army and Navy college benefits for the FY87-97 period. There is a negative time trend in the real present value of Army college benefits, punctuated by several positive spikes. The negative trend is a result of inflation in college costs, which averaged 7 percent during FY87-97. This rate is almost twice the average rate of inflation in prices as a whole. The first spike occurred when there was an increase in the ACF kicker in FY 1993. The second occurred in April 1997 with the introduction of a second tier of higher nominal ACF kicker amounts for selected skills. The third spike occurred in December 1998 when the second tier kickers were replaced by the reestablishment of a single tier kicker at the new, higher level.[10] By FY97, the present value of ACF was lower than it was in FY87, in spite of the introduction of the $40,000 and $50,000 ACF programs.

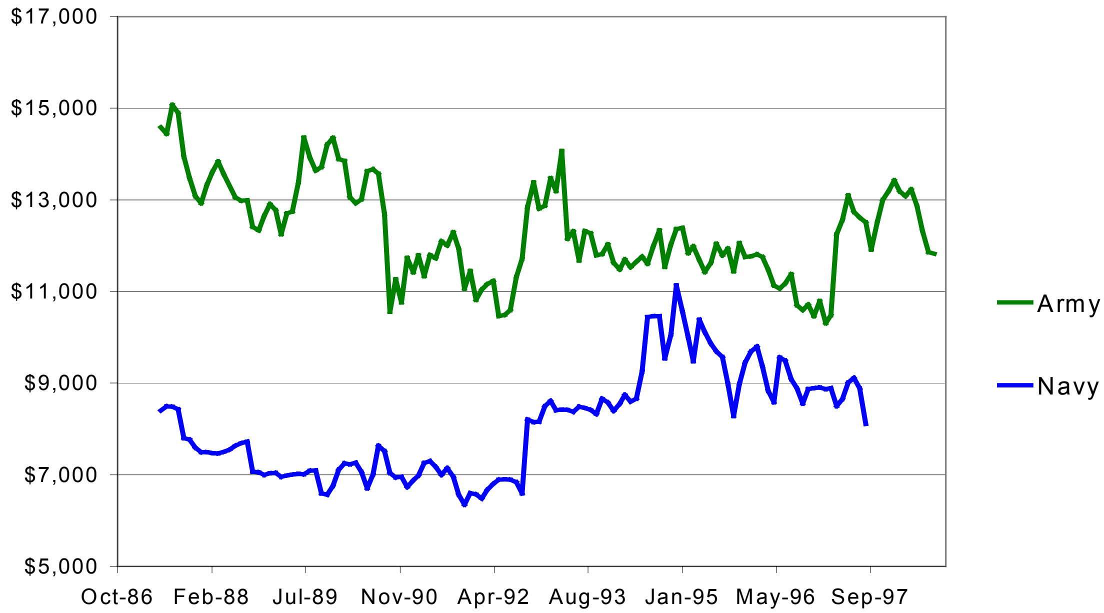
[7] The percent actually receiving NCF in the Navy rather than the percent eligible for NCF was used for two reasons. First, the Navy did not maintain a complete historical record of NCF-eligible ratings. Second, the NCF was initially limited to 2,000 recruits per year; therefore, Navy recruiters tended to use it as a "deal closer" during this period.

[8] Undiscounted measures of college benefits were analyzed as well. The estimated effects of CF were insensitive to the assumed discount rate. The main effect of discounting was on the *level* of benefits – changes in college benefits over time were relatively insensitive to discounting.

[9] The expected present value of college benefits can be written as the eligibility, share-weighted sum of ACF and MGIB benefits. Neglecting MOS and years of service, denoting $\kappa$ as the fraction of recruits eligible for ACF, the expected present value is $PVCOL_t = \kappa_t (ACF_t) + (1 - \kappa_t) MGIB_t$.

[10] The increases for FY93 were: 2-year ACF from $17K to $20K; 3-year ACF from $22.8K to $25K; and 4-year ACF from $25.2K to $30K. The higher-tier ACF amounts introduced in April 1997 were: 2-year ACF, $26.5K; 3-year ACF, $33K; and 4-year ACF, $40K.

**Figure 2.10**
***Expected Present Value of Army and Navy College Benefits, 1998 Dollars***



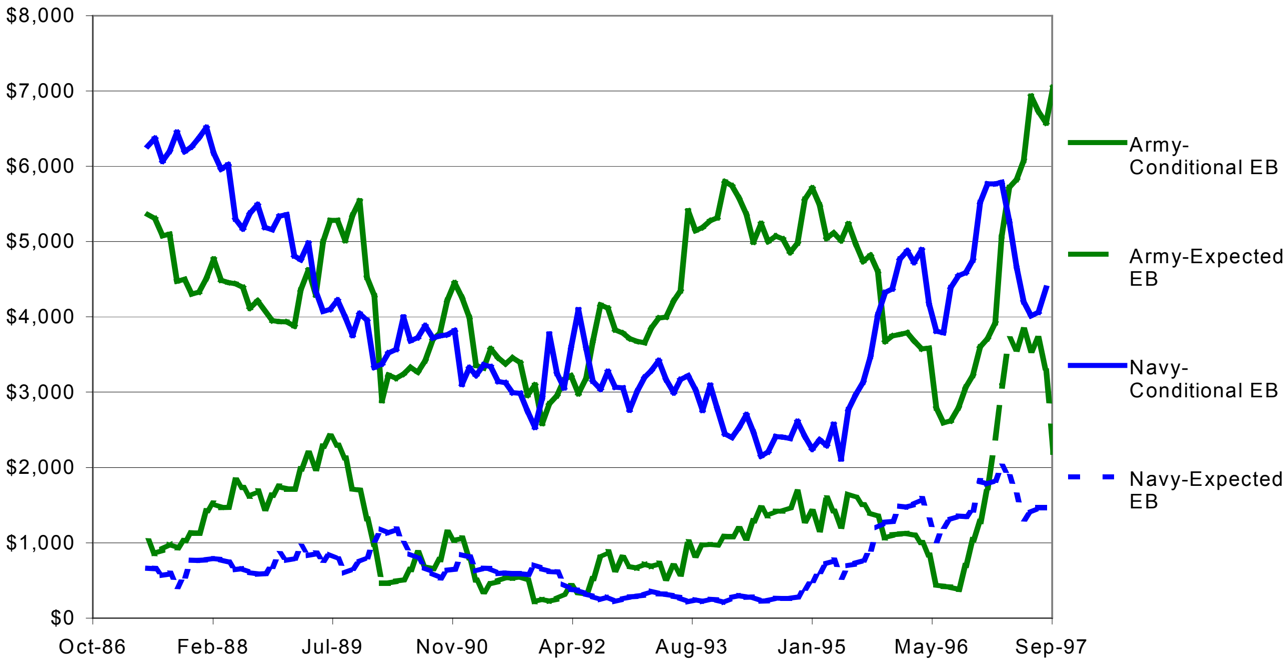

The NCF program, introduced in FY90, is barely perceptible, but the effects of the increased number of seats in FY94 and FY95 are clearly visible in Figure 2.10. However, when the programmed number of seats was reached (i.e., 10,000 per year) inflation took its toll in the form of a slight downward trend in the expected present value of NCF benefits.

It is important to note than the tendency for the real value of college benefits to decline is a result of policy. Specifically, although the MGIB is indexed to the Consumer Price Index, the College Fund kicker amounts are not. Rather, they are set in nominal terms. In order to offset the effects of inflation, kicker amounts would have to be increased regularly. Alternatively, the kickers, too, could be indexed for inflation.

### *Enlistment Bonuses*

Figure 2.11 shows the average value of Army and Navy enlistment bonuses actually received (that is, the bonus conditional on eligibility) as well as the expected enlistment bonus. The expected enlistment bonus adjusts for the fact that not all enlistees receive an EB, and is equal to the average conditional bonus amount multiplied by the fraction of recruits eligible to receive EB. Comparing Figure 2.11 with Figure 2.10, it is seen that the expected dollar value of enlistment bonuses is much smaller than the expected dollar value of the ACF and NCF. There are two reasons for this. First, all new recruits are eligible to receive at least Montgomery GI Bill benefits. Secondly, eligibility for enlistment bonuses has historically been much lower than eligibility for ACF and NCF kickers. Figure 2.11 also demonstrates that the Army and Navy have tended to reduce EB eligibility and amounts significantly when recruiting was easy, and increased them in more difficult recruiting environments.

**Figure 2.11**
***Army and Navy Conditional and Expected Enlistment Bonuses, 1998 Dollars***




### ***Trends in Youth Population and College Enrollment***

The size of the recruitable population is one of the most important determinants of military enlistment. Table 2.4 shows the 17-21-year-old population in two-year increments since 1987 by educational attainment categories. The estimates include both men and women.[11]

**Table 2.4**
***Youth Population by Educational Status (in Millions)***

| *YEAR* | *1987* | *1989* | *1991* | *1993* | *1995* | *1997* |
|---|---|---|---|---|---|---|
| Total | 18.47 | 18.58 | 18.01 | 17.08 | 17.17 | 17.98 |
| Non-High School Grad | 3.69 | 3.58 | 3.14 | 2.61 | 2.62 | 2.69 |
| High School Senior | 2.81 | 2.79 | 2.74 | 2.83 | 2.93 | 3.13 |
| High School Grad | 4.42 | 4.25 | 4.11 | 3.80 | 3.68 | 3.80 |
| College Enrollment | 5.70 | 6.11 | 6.21 | 5.99 | 6.01 | 6.30 |
| High School Senior Plus | 13.15 | 13.37 | 13.27 | 12.81 | 12.82 | 13.44 |
| High School Senior Plus Less College Enrollment | 7.45 | 7.26 | 7.06 | 6.82 | 6.81 | 7.14 |
| Fraction of HSG+ Enrolled in College | 0.56 | 0.58 | 0.60 | 0.61 | 0.61 | 0.62 |

Source: Woods & Poole Economics Inc.

[11] The table omits several educational categories: high-school students who are not yet seniors, GED graduates, Associate Degree (AA) graduates, and college graduates. AA graduates and college graduates are included in the High School Senior Plus totals.

In 1987, there were about 18.5 million young men and women between the ages of 17 and 21 in the United States. This population base dropped by almost 1.5 million between 1987 and 1993, but rebounded to almost 18 million by 1997. The military's focus is on recruiting high school diploma graduates who score at least 50 on the Armed Services Qualification Test (AFQT). Note that the estimate of high school graduates includes high school seniors for whom the dropout rate is very low. According to Table 2.4, there were over 13 million 17-21-year-old high school seniors and graduates in 1997. This population declined by almost 400,000 from 1987 to 1993, but has grown rapidly since and now exceeds the 1987 level by 300,000.

In 1987 approximately 5.7 million 17-21-year-olds were enrolled in college. This number grew by 500,000 between 1987 and 1991 and had increased to 6.3 million by 1997. Of those who had actually graduated from high school, 56 percent were attending college in 1987. By 1997 this percentage had grown to 62 percent.[12] This growth in college enrollment could have reduced the size of the high-quality recruit market by as much as 600,000 from 1987-97 if college students don't enlist in the military. Some of this decline has been mitigated by a decrease in the number of high-school dropouts.

[12] About 2.5 million youth reach the age of 18 each year. In 1997, 67 percent of this population matriculated to a college or university within 12 months of high school graduation. Recall that 62 percent of the 17-21 year-old high school graduate population was enrolled in college in 1997. The college attendance rate of 18 year-olds exceeds the percentage of 17-21 year-old high school graduates who are enrolled in college because not all 18 year-olds remain in college for 4 years.

# CHAPTER 3

# THE PROPENSITY TO ENLIST

## *Introduction*

Measures of youths' propensity to enlist in the military are available in two surveys: the *Youth Attitude Tracking Study (YATS)* and *Monitoring the Future: A Continuing Study of American Youth (MTF)*. These measures of propensity provide information about likely trends in future recruiting. However, an important question is whether propensity reflects underlying preferences of the youth population for military service, or is determined entirely by other factors (e.g., economic conditions, intensity of military recruiting efforts). In other words, does propensity provide information about future recruiting that is not captured by other observable variables? This chapter addresses the following questions:

- How is propensity related to demographic and family background factors?
- Does propensity vary with the state of the economy, military pay, and the intensity of the military recruiting effort represented by recruiters and advertising?
- How much variation in propensity remains after controlling for such observable factors?

## *YATS and MTF Surveys*

YATS is an annual survey of the national youth population aged 16-24 conducted by the Department of Defense.[13] The questions asked in survey focus on youth attitudes regarding military service and include detailed questions on the influence of military advertising and recruiters. The YATS data used in this study span the period 1985-1998.

The University of Michigan's Institute for Social Research conducts the MTF survey of high school seniors annually. This survey, aimed primarily at gathering information on drug use and other life style habits, contains a single question on youth plans with respect to military service, and serves as a useful comparison to YATS. The data from MTF span the period 1976-1997.

There are differences between the YATS and MTF surveys. First, the MTF survey is administered in the spring of the school year, while YATS is administered in the fall. The propensity to join is expected to be lower in the later survey (MTF).[14] Second, MTF respondents answer a single question regarding whether they expect to join the military. In contrast, YATS respondents answer two questions: first an "unaided" question and second an "aided" question. Aided propensity is considerably higher than the unaided measure as one would expect. The analysis in this chapter examines the aided propensity data collected by the YATS survey.

[13]YATS is administered during a 30-minute phone interview to approximately 10,000 youths nationally. The sample population consists of 16 to 24 year-olds living in the United States in households or non-institutionalized group homes with telephones. Excluded from the sample are youth in the military, youth with prior military service, or youth currently accepted for service in the military (Active or Reserve component). Starting in 1990, students with more than two years of college were added to the YATS sample, as were youth living in Alaska and Hawaii.
[14] On average youth lower their propensity to enter the military as the date to enter nears. See Orvis, Satry, and McDonald (1996).

Finally, MTF interviews about 15,000 high school seniors each year, compared with between 8 and 10 thousand 16-24 year-olds in YATS.[15,16]

Figure 3.1 compares overall trends in propensity for White and Black male high school seniors in the two surveys. The MTF data show that propensity increased among both groups in the late 1970s and early 1980s. Figure 3.1 also shows a steady decline in propensity among Whites during the late 1980s and throughout the 1990s. A much larger decline is apparent among Blacks in both surveys. The effect of the smaller YATS sample size is readily apparent in Figure 3.1. YATS propensity estimates show much greater variability than the MTF propensity data. Figure 3.1 also demonstrates that almost all of the decline for Blacks in the MTF survey occurred between 1990 and 1991.

**Figure 3.1**
***Propensities of Male High School Seniors from YATS and MTF***

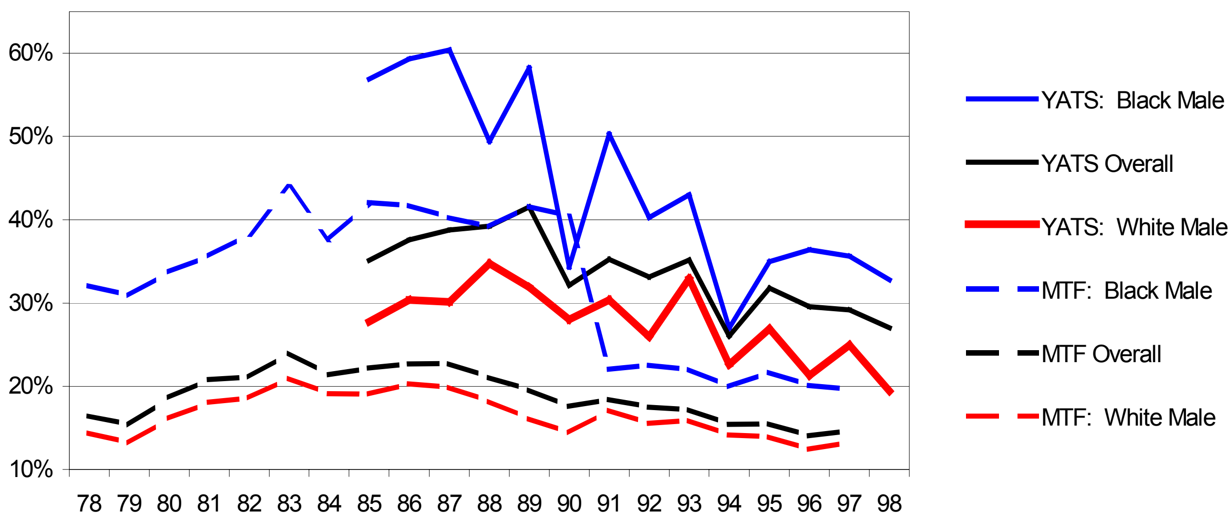



Figure 3.2 displays trends in YATS male active duty propensity by race. Figure 3.3 shows the same data for females. Overall propensity was relatively stable from 1985 through 1989, declined from 1989 through 1992 and remained steady from 1992 through 1998. Again, Black males exhibited the largest decline in propensity, falling from 51 percent in 1986 to 28 percent by 1998. After increasing to 25 percent between 1986 and 1990, the propensity of White males fell gradually to 18 percent in 1996, and has been relatively stable since then.[17]

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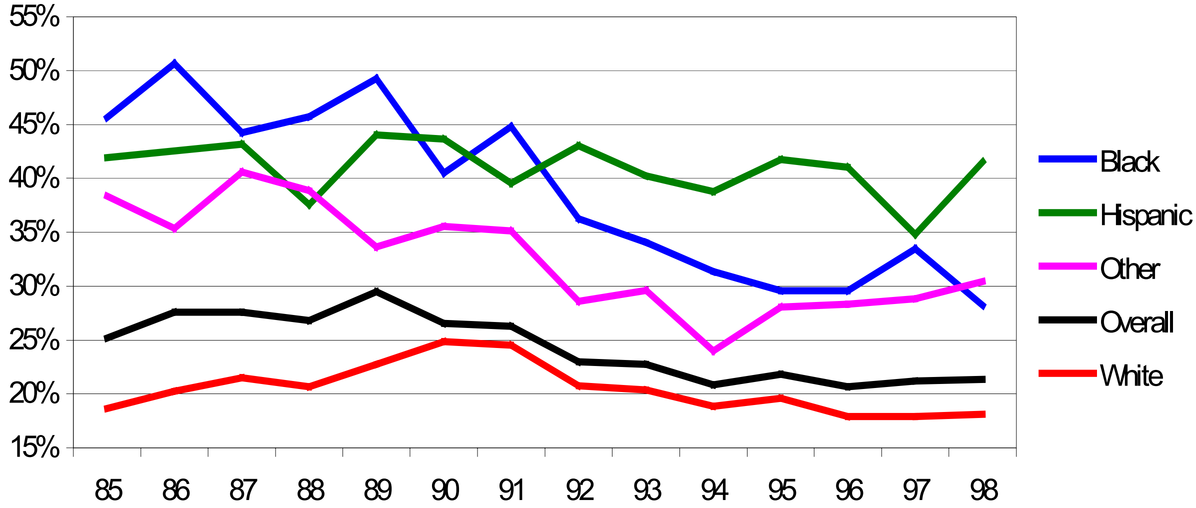
[15] There are other differences in the surveys: (1) the manner in which the surveys are administered: YATS is a 30-minute telephone survey; MTF is a written survey; (2) the wording of the questions pertaining to propensity differs. The MTF asks "How likely is it that you will serve in the armed forces after high school?" (3) The MTF does not separate Active duty propensity from Reserve/Guard propensity as does YATS.

[16] The 1991-1993 surveys originally contained both a new cross-sectional sample and a longitudinal sample of prior respondents. The longitudinal sample has been deleted to prevent oversampling youth who are less propensed to join the military. The resulting cross-section sample has a size of about half that of other years.

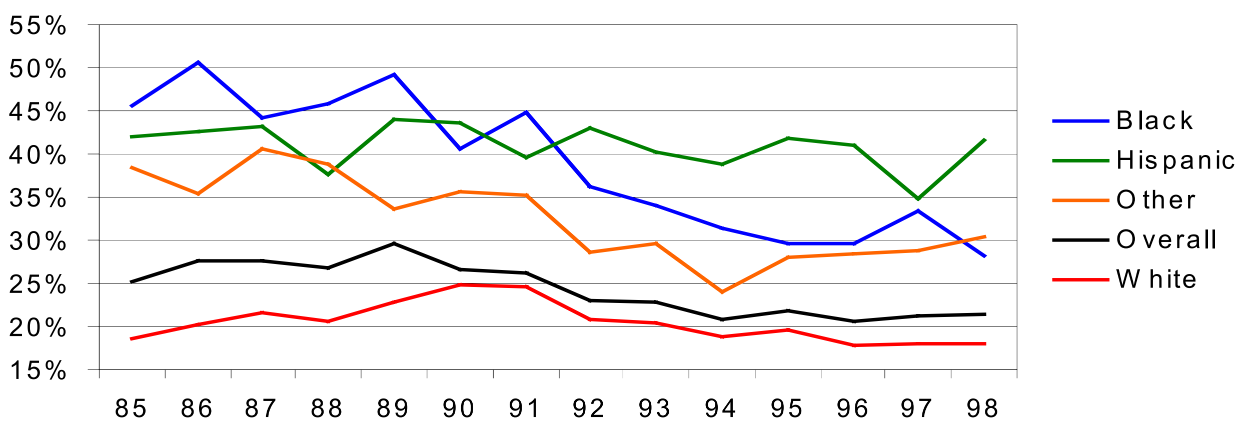
[17] Notice in Figure 3.2 that as the propensity of Nonwhite males declined over time, overall male propensity has approached that of White males. The two propensities have moved similarly since 1990.

**Figure 3.2**
***Male Aided Active Duty Propensity by Race: YATS***




There was no discernable trend in White female propensity over this period. However, there was a marked decline among Black females between 1986 and 1992 (from 32 percent to 16 percent), followed by a slight upward trend to 20 percent. The propensity among Hispanic females, like that of Hispanic males, was relatively steady at around 20 percent.

**Figure 3.3**
***Female Aided Active Duty Propensity by Race: YATS***




## *Determinants of Propensity*

Probability equations (Probit models) of propensity were estimated to determine the extent to which changes in propensity are related to changes in the economic environment and the intensity of the recruiting effort.[18] The economic environment was represented by two

[18]Probit is a method for estimating the probabilities of variables that have discrete outcomes based on a set of independent variables that determine the discrete outcome. When a discrete variable has two outcomes (e.g., youth has positive propensity versus youth does not), the probit model fits an S-shaped relationship between the

variables: the civilian unemployment rate and the ratio of military to civilian pay by state.[19] The intensity of recruiting effort was defined by the number of recruiters and advertising (dollars or impressions) per youth within a state. In addition, controls were included for a host of individual demographic characteristics in the equations.

## *YATS Analysis*

The equations were estimated by race and sex for the full YATS sample for the period 1985-1998. Data for recruiter and advertising impression and expenditure variables were not available for 1998 and they were therefore not included in this first set of regressions. A variable that measures youths' *awareness* of advertising was however included for advertising effects.[20] The equations also included (dummy) variables representing Census regions and years respectively to capture the influences of omitted state specific and time-related influences on propensity.

***Economic Factors.*** Table 3.1 shows estimates of marginal probabilities, defined as changes in propensity due to small changes in each variable, evaluated at mean values of the propensity variable.[21] Detailed estimates of each equation are in Appendix B. Estimates of time-related effects are displayed in Figures 3.5 and 3.6 below.

The estimates in Table 3.1 demonstrate that military pay and unemployment have very small though statistically significant effects on propensity of males regardless of race/ethnicity. For instance, a 10 percent increase in military relative to civilian pay would increase the propensity of White males by only .3 percent. At this rate, military pay would have to more than double for the propensity of White males to increase by 10 percent, a relatively modest gain. Results are similar for Black males as well. Females are even less sensitive to pay. Estimated effects of pay are less than half what they are for males. Changes in unemployment have little impact on propensity for males and females alike. With the exception of Black females, estimates of unemployment effects are much lower than even the effects of pay on propensity. In fact for White females, the effect is essentially nonexistent.

***Family Background and Academic Achievement***. The higher the educational attainment of parents of White males, the lower their propensity for military service. This relationship appears to be much less important and systematic however, for Nonwhite males and all females.

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probability of an outcome and the explanatory variables. If P is the probability of an outcome (e.g., positive propensity) and X is an explanatory variable, then the change in P for a small change in X is $\Delta P = .3989*\exp(-.5z^2)*b*\Delta X$ where b is the probit coefficient associated with the variable X, exp denotes exponential, and z is the standard normal random variable associated with the probability P. For example, if P equals .5, z equals 0. In this case, $\Delta P = .3989*b*\Delta X$. A change in X has the largest effect on P when P = .5. For more details about the Probit procedure, see Johnston and DiNardo (1997) or Greene (2000).

[19] Civilian pay by race and sex was estimated using data from the annual March Current Population Surveys (CPS) for years 1985 through 1997.

[20] Appendix A explains in detail the construction of the measures of advertising awareness.

[21] The marginal effect of each variable is the change in the probability of being positively propensed associated with that variable. For each group in Table 3.1, the marginal effect of each variable is evaluated at the sample mean of propensity. For example, if the sample average propensity is 0.18, then the standard normal z statistic associated with P = 0.18 is –0.92. Therefore, the marginal effect of each variable is $\Delta P = .3989*\exp(-.5(-.92)^2*b*\Delta X = 0.2613*b*\Delta X$. When P = 0.18, the marginal effect is roughly one-quarter of the probit coefficient.

Academic achievement was measured by individuals' self-reported letter grade averages (mostly As, mostly As and Bs, mostly Cs, etc.). Among both White males and White females, individuals who report mostly A and mostly B grades have significantly lower propensities than individuals reporting mostly grades of C. For White males, propensity is also lower for students who report grades of D and F then grades of C. The relationship between academic achievement and propensity for Nonwhite males and females is much less pronounced.[22]

**Table 3.1**
***Changes in Propensity to Enlist: Marginal Probabilities Evaluated at the Mean***

| | ***White Male*** | ***Nonwhite Male*** | ***White Female*** | ***Nonwhite Female*** |
|---|---|---|---|---|
| Military/Civilian Pay Ratio | 0.036 * | 0.033 * | 0.015 * | 0.014 * |
| Unemployment Rate | 0.006 * | 0.010 * | 0.002 | 0.013 * |
| Hispanic (Black omitted) | | 0.047 * | | -0.025 * |
| Other Race | | 0.033 * | | -0.017 * |
| Mother some HS (HS graduate omitted) | 0.026 * | 0.059 * | 0.009 | 0.046 * |
| Mother some college | -0.004 | 0.001 * | -0.009 | 0.026 * |
| Mother College Grad | -0.018 * | -0.005 | -0.025 * | -0.010 |
| Father some HS (HS graduate omitted) | 0.004 | -0.017 | 0.013 * | -0.021 * |
| Father some college | -0.010 * | 0.004 | -0.002 | -0.001 |
| Father College Grad | -0.034 * | -0.031 | 0.007 | 0.003 |
| Did not complete HS (HS graduate omitted) | 0.093 * | 0.103 * | 0.034 * | 0.063 * |
| HS Sophomore or Junior | 0.232 * | 0.228 * | 0.147 * | 0.179 * |
| HS Senior | 0.158 * | 0.168 * | 0.093 * | 0.134 * |
| Grades A (Grade C omitted) | -0.103 * | -0.028 | -0.043 * | 0.003 |
| Grades A and B | -0.035 * | 0.007 * | -0.016 * | 0.006 |
| Grades D | -0.016 * | -0.004 * | 0.000 | -0.052 * |
| Grades F | -0.075 * | -0.075 | 0.057 | -0.238 * |
| AD: Aware of newspaper & magazine ads | 0.030 * | 0.031 * | 0.033 * | 0.029 * |
| AD: Aware of TV & radio ads | 0.029 * | -0.006 * | 0.019 * | 0.020 * |
| RG: Aware of newspaper & magazine ads | 0.013 | -0.002 | 0.005 | 0.036 * |
| RG: Aware of TV & radio ads | 0.000 | 0.002 | 0.004 | -0.030 * |
| Mid Atlantic (New England omitted) | -0.040 * | 0.032 | -0.005 | -0.035 |
| East North Central | -0.032 * | -0.020 | -0.024 * | -0.056 * |
| West North Central | -0.038 * | 0.033 | -0.026 * | -0.048 |
| South Atlantic | -0.001 | 0.031 | -0.001 | -0.036 * |
| East South Central | -0.024 * | 0.003 | -0.016 | -0.071 * |
| West South Central | 0.006 | 0.021 | -0.001 | -0.049 * |
| Mountain | -0.007 | -0.007 | 0.019 | -0.018 |
| Pacific | -0.019 * | -0.007 | 0.007 | -0.065 * |

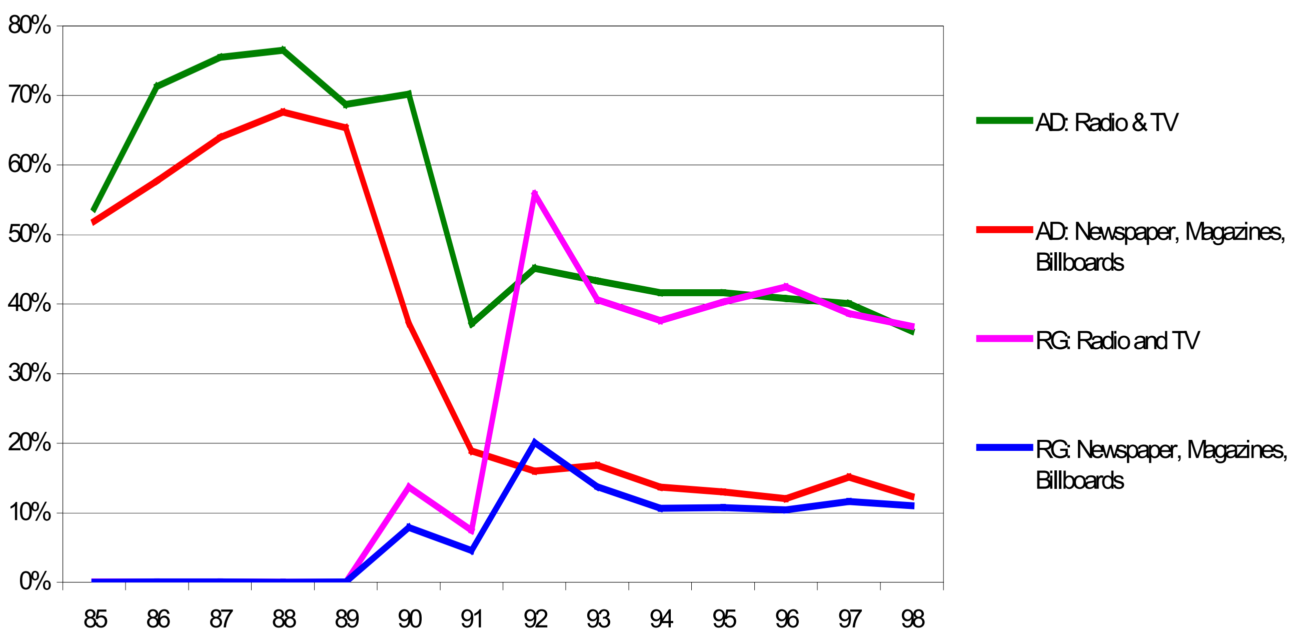
* Significant at the .05 level

[22] Note that propensity is lowest for both high and low academic achievement for White males and White females with higher grades.

***Intensity of Recruiting Effort.*** Data on youth's advertising awareness were used to measure the intensity of recruiting effort for the period 1985-98. The awareness categories include (1) Active Duty (AD) print (magazines, newspapers and billboards); (2) Active Duty broadcast (TV and radio); (3) Reserve/Guard (RG) print; and (4) Reserve/Guard broadcast.[23] Trends in awareness are shown in Figure 3.4.

Youth who are aware of advertising are 2 to 3 percentage points more propensed than youth who are not according to the estimates in Table 3.1. In addition, as one would expect, AD propensity is more strongly related to awareness of active duty advertising than awareness of RG advertising. An important caveat concerning these results, however, is that the direction of causality may be from propensity to awareness rather than the other way around. That is, youth that are more inclined to join the military may tend to pay more attention to advertising about the military.

**Figure 3.4**
***Awareness of Military Advertising: YATS***




Relationships between advertising, advertising awareness, and propensity were also estimated using data from the period 1989-1997.[24] The first task was to determine whether advertising awareness was related to the actual amount of advertising measured by either advertising expenditures or impressions. The YATS data were matched to data on advertising expenditures and advertising impressions in the previous year. Probability (Probit) equations were estimated where the dependent variable measured whether a youth was aware of

[23] The construction of these measures of advertising awareness is detailed in Appendix A.
[24] The Army and Marine Corps advertising data begin in FY 1988, but current propensity is specified as a function of advertising during the previous year.

advertising in a specific medium for a specific military Service. Other variables in the equations included the demographic characteristics in the propensity analysis above.[25]

Table 3.2 summarizes the regression results. The first column reports the estimated change in advertising awareness due to a 10 percent change in advertising expenditure for selected media. Mean levels of advertising per capita and advertising awareness by Service and medium are shown in the remaining columns. Clearly, awareness is positively related to advertising expenditures and the estimates are highly significant in a statistical sense.

**Table 3.2**
***Effects of 10% Increase in Advertising Expenditures on Ad Awareness***

| *Media/Service* | *Increase in Awareness* | | *Per Capita Expenditures* | *Mean Ad Awareness* |
|---|---|---|---|---|
| Navy TV | 0.667 | * | $0.397 | 0.337 |
| Navy Radio | 0.116 | * | $0.145 | 0.092 |
| Navy Magazine | 0.261 | * | $0.164 | 0.118 |
| Army TV | 0.136 | * | $1.180 | 0.527 |
| Army Radio | 0.208 | * | $0.343 | 0.165 |
| Army Magazine | 0.257 | * | $0.272 | 0.138 |
| Army Newspaper | 0.157 | * | $0.146 | 0.052 |

* Significant at the .05 level
Note: Navy radio regression included year effects

The second task was to determine whether advertising translates into higher propensity. Advertising expenditures and impressions were added across Services by medium. Probability models of propensity were estimated as a function of these DoD advertising totals. The estimates, reported in Tables 3.3 (dollars) and 3.4 (impressions), show there is little evidence of a relationship between advertising and propensity. For most groups -- males of both race groups in particular -- neither advertising dollars nor impressions have positive, statistically significant effects on propensity. This finding suggest that the positive relationship between propensity and advertising awareness found earlier may well be due to reverse causality. Finally, the propensity models also included the average number of recruiters per youth by state in the previous 12 months. Although the estimated effects of recruiters are positive, they are statistically insignificant.

Taken together, these findings suggest that youth propensity does not respond to or reflect the intensity of Service recruiting efforts. Youth propensity is not entirely exogenous -- it varies modestly, for example, with the state of the civilian economy. However, for the most part, youth propensity seems to represent an underlying unobserved preference for military service.

[25] Variables (dummy) indicating year were initially included in all regressions to capture unmeasured time-related effects. With the exception of Navy radio (expenditures), the year dummies render the estimated coefficients on advertising statistically insignificant. Without the time variables included, the estimated coefficient on radio advertising (expenditure) for the Navy is higher by a factor of four. The more conservative specification is reported.

**Table 3.3**
***Percent Change in Propensity Due to 10% Change in Advertising Expenditures***

| *Media* | *White Males* | | *Nonwhite Males* | | *White Females* | | *Nonwhite Females* | | *Mean Impressions* |
|---|---|---|---|---|---|---|---|---|---|
| TV | 1.060 | | 1.943 | | -0.765 | | -4.944 | | 1.887 |
| Radio | -0.044 | | 0.022 | | 5.081 | * | 2.577 | | 0.479 |
| Magazine | 1.358 | | -1.528 | | 11.676 | * | 0.584 | | 0.568 |
| Newspaper | 0.459 | | 0.414 | | -0.358 | | 3.770 | * | 0.148 |
| Direct Mail | -1.759 | * | -1.176 | | 1.580 | | -1.617 | | 0.290 |

* Significant at the .05 level

**Table 3.4**
***Percent Change in Propensity Due to 10% Change in Advertising Impressions***

| *Media* | *White Males* | | *Nonwhite Males* | | *White Females* | | *Nonwhite Females* | | *Mean Impressions* |
|---|---|---|---|---|---|---|---|---|---|
| TV | 1.374 | | 3.229 | * | 3.465 | | -1.971 | | 30.577 |
| Radio | 0.185 | | 0.030 | | 1.138 | | 0.815 | | 71.410 |
| Magazine | 2.015 | | -0.850 | | 8.094 | | -1.280 | | 31.832 |
| Newspaper | 0.418 | | -0.279 | | -1.535 | | -0.294 | | 8.048 |
| Direct Mail | 0.013 | | 0.120 | | -0.351 | | 0.900 | * | 24.605 |

* Significant at the .05 level

***Propensity and Parents' Military Service.*** The preferences of youth are formed largely within the environment provided by their parents. The previous finding that propensity tends to be lower among youths with better-educated parents illustrates this point. Another potentially important factor of key interest and importance to DoD policymakers is whether parents ever served in the military. In 1995, questions were added to YATS that asked all respondents about their parents' military service.[26] To examine the effects of military service, propensity regression equations that included a (dummy) variable for parents' military service were estimated using data for 1995-98. The results are displayed in Table 3.5. Clearly, propensity is positively and significantly related to parents' past military service. The estimated effect is especially large for white males and nonwhite females. It is worth noting that this finding is consistent with other research that has evaluated the relationship between the size of the veteran population and enlistment in the U.S. Military.[27]

[26] Prior to that year, this question was asked only of respondents who reported that they talked with their parents about joining the military.
[27] See Schmitz and Zucher (1996) for an earlier analysis of the relationship between propensity and advertising awareness.

**Table 3.5**
***Effect on Propensity of Parents' Military Service, by Gender and Race***

| *Gender/Race* | *Effect of Parents' Military Service* | | *Percent of Parents Veterans* | *Average Propensity* |
|---|---|---|---|---|
| White Male | 0.037 | * | 0.280 | 0.161 |
| Nonwhite Male | 0.018 | * | 0.196 | 0.311 |
| White Female | 0.025 | * | 0.262 | 0.055 |
| Nonwhite Female | 0.041 | * | 0.184 | 0.172 |

* Significant at .05 level

***Unexplained Trends in Propensity.*** The propensity models estimates described in this chapter included year variables to capture the influence of omitted time-related factors. In particular, the regression equations estimated with data for the period 1985-98 provide estimates of these residual effects, or trends over time.[28] This unexplained time trend was allowed to differ for youth of low and high ability.[29] Figures 3.5 (males) and 3.6 (females) display estimates of these trends. The estimates are relative to the base year 1985, with positive values indicating an increase relative to 1985, and negative values indicating a decrease. These trends represent changes in underlying preferences of youth for military service.

Several features of the trends for males in Figure 3.5 are worth pointing out. First, the unexplained trend in White low-ability males was strongly positive between 1985 and 1990. Despite the decline since 1990, White male propensity in 1998 was still higher than it was in 1985. Secondly, the trend in residuals among high-ability white males is similar but is much lower in magnitude. Among this group, the unexplained trend fell below its 1985 level in 1992, and declined gradually until 1996 before leveling out. The unexplained portion of the decline in white male propensity between 1990 and 1997 represents about a 25 percent decline in actual propensity. The unexplained trend in propensity of low-ability Nonwhite males peaked one year earlier than for Whites, but is otherwise similar. Among high-ability Nonwhite males, this trend shows more variability, and has fallen substantially more than for Whites.[30]

Figure 3.6 shows unexplained trends in propensity among females and reveals that residual propensity fell markedly below its 1985 level for one group-Nonwhite high-ability females. For high-ability White females, the residual trend in 1998 is slightly below its 1985 level. The trends for low-ability Whites and Nonwhites increased markedly during this period and are well above their 1985 levels. The trends for high-ability Nonwhite females varied substantially during this period and have also been above their 1985 level since 1994.

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[28]These models exclude variables that measure the intensity of recruiting effort, which were available only for 1989-97. Recall that the omitted variables were not significant determinants of propensity. Therefore, time trends are unlikely to be influenced by variations in recruiting effort.
[29]YATS contains a dummy variable that is equal to one for individuals likely to score 50 or better on the AFQT (as constructed by Orvis and Gahart, 1989), and zero otherwise.
[30] The variability of the estimated time effects is probably due to the small sample sizes for this group compared with sample sizes for high-ability white males.

**Figure 3.5**
***Unexplained Time Trends in YATS Propensity:  White and Nonwhite Males***

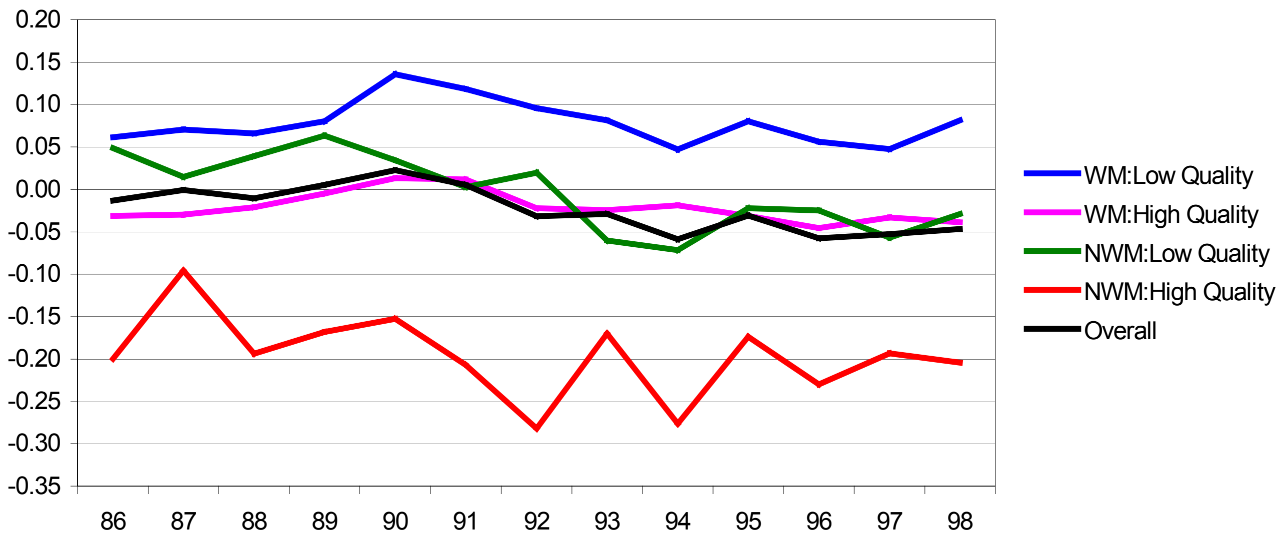
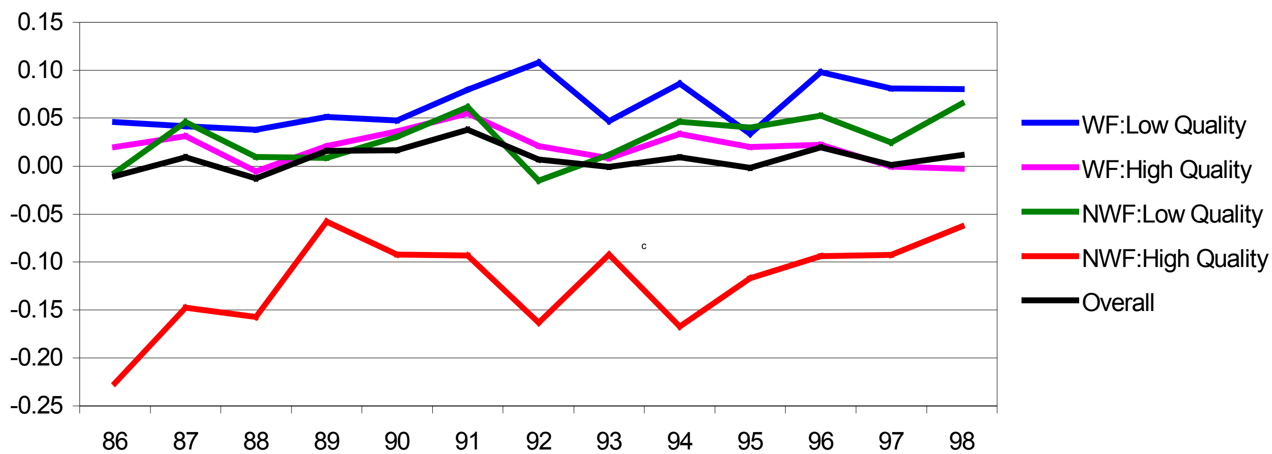



**Figure 3.6**
***Unexplained Trends in YATS Propensity:  White and Nonwhite Females***




### *MTF and Plans to Go to College*

Monitoring the Future contains only one question concerning plans to join and awareness of opportunities in the military.  The lack of geographic detail in the public use file of MTF prevents estimation of the impact of the economic factors, relative military pay and unemployment.  MTF does include, however, one question that is of particular relevance in today's economic environment that cannot be as successfully analyzed with YATS.  Specifically,

it asks high school seniors whether they plan to attend a 2-year college or a 4-year college.[31] This makes it possible to examine how propensity to enlist in the military is affected by college plans.

To analyze this relationship, propensity equations were estimated using MTF data for the period 1978-97. In addition to college plans, propensity is defined to be a function of high school grades, family background factors, the unemployment rate in the individual's geographic region of residence, variables for geographic region of residence, and year dummies.[32] The estimates are reported in Table 3.6. On the whole, the results indicate that high academic achievement, both past and planned, are negatively correlated with propensity. For example, the propensity to join the military is 1.3-4.1 percentage points lower among individuals who report having above-average grades in high school. This effect is not insubstantial – about 10 percent of the average value of the male propensity variable. Although the estimated effects are smaller in magnitude for females, they are larger compared to the average than for males. In terms of plans to attend college, propensity to join the military is significantly lower among those who plan to attend a 4-year college. Qualitatively, the effects for White and Nonwhite females are similar to those of males. However, the estimated effects of 2-year college plans on propensity are quite different. Propensity is statistically related to 2-year college plans only for Black men and Other females. Moreover, these two groups are estimated to have *higher* propensities to join the military.

**Table 3.6**
***Effects of Grades and College Plans on Propensity of White, Black and Other High School Seniors in the MTF***

| | *White Male* | *Black Male* | *Other Male* | *White Female* | *Black Female* | *Other Female* |
|---|---|---|---|---|---|---|
| Average propensity 1978-1997 | 0.165 | 0.350 | 0.220 | 0.036 | 0.164 | 0.078 |
| Above Average Grades | -0.013* | -0.040* | -0.041* | -0.015* | -0.034* | -0.034* |
| Plan 4yr college | -0.085* | -0.174* | -0.086* | -0.014* | -0.071* | -0.007 |
| Plan 2yr college | 0.001 | 0.026* | 0.037 | 0.001 | -0.004 | 0.034* |

*Significant at 1 the percent level.

To determine whether trends in plans to attend college can explain the decline in propensity observed in YATS and MTF, the estimates in Table 3.6 are used to compute the predicted change in propensity between 1985 and 1997 due solely to changes in college plans. Table 3.7 reports these calculations. The results show that between 1985 and 1997, about a third of the decline in propensity among white males can be traced to changes in college plans. White male propensity declined 2.9 percent during this period. At the same time, the fraction of white males planning to attend a 4-year college rose from 61.9 percent to 73.1 percent. The predicted change in propensity is thus equal to - 0.085 times 2.9 percent, or about 1 percent. Similar calculations show that 14 percent of the 22.4 percent decline in Black male propensity can be

[31] YATS does ask youth what they plan on doing in the next two years, and attending school is one possible response. However, many youth are still in high school at the time of the survey, while a substantial number of others are college students or college graduates. The question in the MTF survey is more specific and hence more useful for the purpose here.
[32] To save space, full Probit estimates are not provided but are available upon request.

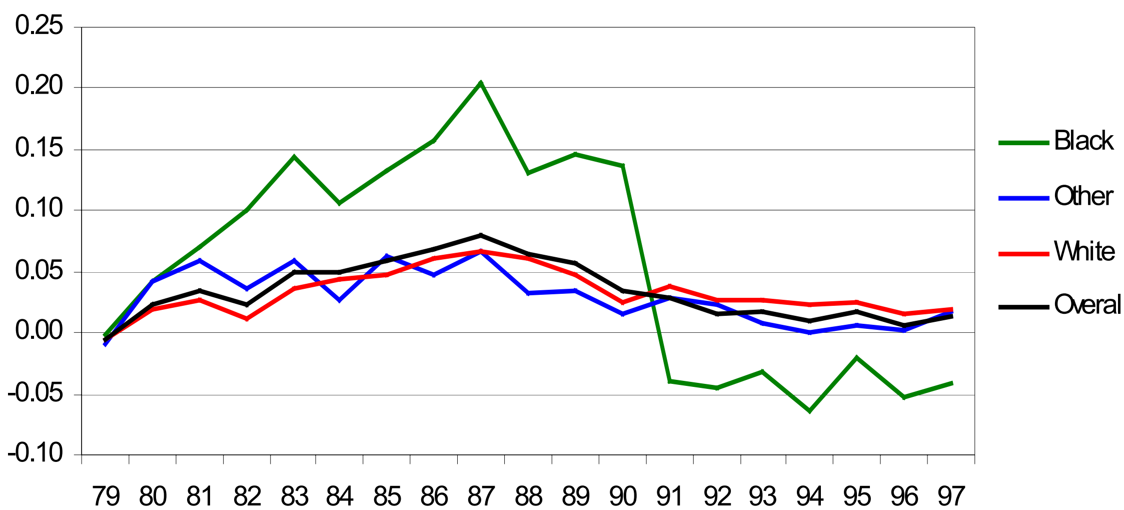
attributed to plans to attend a 4-year college. However, for males of other races, only about one-quarter of the observed propensity drop can be explained to the rise in the fraction planning to attend a 4-year college.

**Table 3.7**
***Estimated Impact of Rise in Fraction of Males Planning 4-Year College on Propensity to Enlist From 1985 to 1997***

| | *White Male* | *Black Male* | *Other Male* |
|---|---|---|---|
| Propensity in 1985 | .191 | .421 | .238 |
| Fraction planning 4-yr college in 85 | .619 | .587 | .614 |
| Propensity in 1997 | .162 | .197 | .181 |
| Fraction planning 4-yr college in 97 | .731 | .772 | .774 |
| Overall change in propensity | -0.029 | -0.224 | -0.057 |
| Change due to rise in 4-yr college | -0.010 | -0.031 | -0.014 |

Finally, after accounting for a number of changes over time in economic and demographic factors, including plans to attend college, there remains an unexplained trend in MTF propensities similar to that found in the previous analysis of YATS propensity. The unexplained MTF trends are displayed in Figure 3.7.

**Figure 3.7**
***Unexplained Time Trends in Male MTF Propensity***



# CHAPTER 4

# ANALYSIS OF ENLISTMENT SUPPLY

This chapter describes the analysis of high-quality enlistment supply conducted for this study.[33] The database consists of monthly data by Service and state for the period FY88-97. This section first describes the basic form of the model estimated, followed by a discussion of econometric issues. Research findings and their implications are examined in the final section.

## *Basic Model*

The empirical model follows the approach of Warner (1991) and is a simplified version of the model found in Dertouzos, Polich, and Press (1986). Let $H_i$ denote the high-quality enlistments in Service i. $H_i$ is assumed to depend upon a set of exogenous market factors (X), the recruiting resources of Service i ($R_i$), the effort of recruiters in Service i ($E_i$), and the recruiting efforts of the other services ($E_0$). It is assumed that the relationship takes the following form:

$$\ln H_i = \alpha' X + \beta' \ln R_i + \ln E_i + \delta' \ln E_0 + v_i \qquad (4.1)$$

Recruiter effort is of course unobservable.[34] The database here included data only on the total goal for three of the four Services. Therefore, recruiter effort in Service *i* was specified as $\ln E_i = \gamma \ln(G_i/H_i)$ where $G_i$ denotes the total goal in Service i. It is expected that $\gamma > 0$: recruiters expend more effort the higher the total recruiting goal is set relative to the supply of high-quality recruits. Let other Services' effort be measured as $\ln E_0 = \ln(H_0/G_0)$, where $H_0$ is the sum of the other Services' high-quality enlistments and $G_0$ is the sum of their goals. Effort of the other services is measured by the fraction of their combined total goal achieved by their respective total numbers of high-quality recruits. Taking logarithms and rearranging,

$$\ln H_i = \alpha X + \beta \ln R_i + \gamma \ln G_i + \delta \ln(H_0/G_0) + u_i \qquad (4.2)$$

where $\alpha=\alpha'/(1 - \gamma)$, $\beta=\beta'/(1 - \gamma)$, $\gamma=\gamma'/(1 - \gamma)$, and $\delta=\delta'/(1 - \gamma)$.

The parameter $\delta$ measures the spillover effect of other Services' high-quality recruiting effort on the Service in question. A positive value indicates cooperation in recruiting while a negative value would suggest competition in recruiting.[35]

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[33] Readers are referred to Appendix B for a detailed review of previous studies.
[34] In Dertouzos, Polich, and Press (1986), recruiter effort depends on the supplies of both high-quality and low-quality recruits relative to respective recruiting goals (see equation B.13 of Appendix B).
[35] If random shocks to enlistment, u, are positively correlated between Services, the numerator of this "spillover" variable ($H_0$) will be positively correlated with own-Service high-quality enlistment ($H_i$). This would bias estimates of inter-Service relationships upward even if there were no "spillover" effects. To eliminate this bias, the sum of other Service predicted high-quality enlistments was used for the numerator of the spillover variable. The predicted values were obtained from least-squares estimates of a regression of $\ln H_i$ on $X_i$ and $R_i$ for each Service. This two-stage procedure gives *consistent* estimates of inter-Service relationships, where consistency means that the estimated relationship converges to the true relationship as the sample size increases.

When models were estimated in the form of equation (4.2), the estimated recruiter and goal elasticities were somewhat low compared with previous estimates in the literature. The source of problem was a high degree of collinearity between (the natural logs of) recruiters and goals in the data. By assuming that goals and recruiters enter separately in natural logarithms, equation (4.2) assumes that a 10 percent increase in contract goals yields the same percentage increase in enlistments, regardless of the level of recruiters. Because goals are implemented through recruiters, this assumption seems dubious.

Equation (4.2) was therefore modified to allow the effects of goals to vary with the level of recruiters as follows:

$$\ln H_i = X\alpha + \beta_1 \ln R_i + \beta_2(G_i/R_i) + \beta_3(G_i/R_i)\ln R_i + \delta \ln(H_0/G_0) + u_i \qquad (4.3)$$

This formulation allows the effects of goals to interact with the level of recruiters (fourth term on the right hand side of equation 4.3). The elasticities of enlistment with respect to recruiters and goals are not constant, as they were in equation (4.2). The elasticities of high-quality enlistment with respect to recruiters and goals implied by equation (4.3) are given by

$$\frac{\partial \ln H}{\partial \ln R} = \beta_1 + \beta_3 \frac{G}{R}$$

and

$$\frac{\partial \ln H}{\partial \ln G} = \frac{G}{R}(\beta_2 + \beta_3 \ln R).$$

### *Econometric Issues and Estimation Strategy*

This section discusses econometric issues that were addressed in order to estimate equation (4.3). The Service subscript i is dropped from equation (4.3) and subscripts for state (s) and month (t) added in the following discussion.

The first issue is the scaling of the variables for enlistments, recruiters, and advertising. Some studies have estimated enlistment supply models using the actual value of high-quality enlistments as the dependent variable and including a measure of the youth population as a right-hand side variable. Others have divided enlistments, recruiters, and advertising by the youth population, so that these variables are measured as enlistments, recruiters, and advertising per youth population. The analysis below follows the latter convention, scaling the relevant variables by the sum of (1) a state's 17-21 year-old population that is currently in high school and (2) the 17-21 year-old population that holds a high school degree or better.

Consider now the estimation procedure. Equation (4.3) can be rewritten as $Y_{s,t} = Z_{s,t}\beta + u_{s,t}$ where $Y_{s,t}$ is the natural logarithm of high-quality contracts per youth population (as defined above) and $Z_{s,t}$ now includes all of the explanatory variables on the right-hand side of equation (4.3). The appropriate econometric technique for estimating this equation depends on the properties of the random error term $u_{s,t}$.

If $u_{s,t}$ is distributed with mean 0 and constant variance $\sigma^2$, then the method of Ordinary Least Squares (OLS) provides consistent estimates of this equation. Given that the data are time series-of-cross sections, however, there are likely to exist unobserved variables that affect high-quality enlistments in a given state and month, and that are correlated with the right-hand side variables in (4.3). Such unobserved factors cause OLS estimates to be biased and inconsistent. If, for example, recruiters are systematically located in states that have higher (unmeasured) enlistment propensities, OLS estimation will result in upward-biased estimates of the productivity of recruiters.

The models were estimated using a Two-Way Fixed Effects (TWFE) approach that eliminates source of bias in OLS estimates. Assuming that the state- and month-specific factors are fixed over time, the random error $u_{s,t}$ can be written as the sum of three terms:

$$u_{s,t} = \phi_s + \tau_t + \varepsilon_{s,t} \tag{4.4}$$

where $\phi_s$ is a fixed effect for state s that remains constant over time, $\tau_t$ is a fixed time effect that is the same for all states, and $\varepsilon_{s,t}$ is a random variable with zero mean that captures the effects of remaining omitted variables. By hypothesis, $\phi_s$ and $\tau_t$ are correlated with the right-hand side variables in equation (4.3). The random shock $\varepsilon_{s,t}$ in equation (4.4) is assumed to have a mean of zero, a constant variance, and is assumed to be uncorrelated with any of the explanatory variables.

Because $\phi_s$ is fixed over time, and $\tau_t$ is fixed over cross-sectional units, their effects can be netted out by subtracting out cross-sectional and time-series means on both sides of equation (4.3). Specifically, the dependent variable ($Y_{s,t}$) and right hand side variables, ($Z_{s,t}$), are normalized as follows:

$$y_{s,t} = Y_{s,t} - \overline{Y}_{s,\bullet} - \overline{Y}_{\bullet,t} + \overline{Y}_{\bullet,\bullet} \tag{4.5}$$

and

$$z_{s,t} = Z_{s,t} - \overline{Z}_{s,\bullet} - \overline{Z}_{\bullet,t} + \overline{Z}_{\bullet,\bullet} \tag{4.6}$$

where (1) $\overline{Y}_{s,\bullet}$ and $\overline{Z}_{s,\bullet}$ are the average values of Y and Z in a given state over the data period, (2) $\overline{Y}_{\bullet,t}$ and $\overline{Z}_{\bullet,t}$ are the national average values of Y and X at a point in time, and (3) $\overline{Y}_{\bullet,\bullet}$ and $\overline{Z}_{\bullet,\bullet}$ are the grand averages of Y and Z in the data. The variables $y_{s,t}$ and $x_{s,t}$ are deviations of Y and X from state and time averages. In the deviation form of the model, $y_{s,t} = z_{s,t}\beta + \varepsilon_{s,t}$, the error components $\phi_s$ and $\tau_t$ no longer appear. Hence, the Ordinary Least Squares regression of $y_{s,t}$ on $z_{s,t}$ provides unbiased and efficient estimates of the parameter vector β.[36]

Although the TWFE model eliminates potential biases, its application raises an issue critical to this study. It is not possible for this model to identify the influence of a variable that does not change within a state over time within the TWFE structure. For example, consider the

[36] Alternatively, one could use Least Squares with Dummy Variables (LSDV). Equation (4.3) would be augmented to include dummy variables for each state and month (minus 1 in each case). LSDV is unwieldy when the number of cross-section units or time periods is large.

percentage of each state's population that is qualified to enlist in the military as high-quality, referred to as the Qualified Military Available (QMA) population. The percentage of a state's population that is QMA varies by state but tends to be stable over time. As a result, the TWFE model cannot estimate the effects of QMA. Similarly, the effects of variables that change over time but not across states also cannot be estimated. The most important variables in this group are the various measures of incentive programs, which do not vary by state. Their values will however, change over time as service incentive programs change.

To address this issue, the vector Z was first partitioned into two components: $Z^1$, which included right hand side variables that varied substantially over both states and time; and $Z^2$, which included variables that varied either by state or over time, but not both. $Z^1$ variables included recruiters, goals, advertising, and unemployment. The vector $Z^2$ included percent Black, percent Hispanic, population density, state percent veterans, percent enrolled in college, state median family income, percent QMA, and measures of the expected present value of the ACF, NCF and EB programs for the Army and Navy.

Estimation of equation (4.3) then proceeded in two stages, or steps. In the first step (Step 1), $y_{i,t}$, was regressed on $z^1_{i,t}$ (see equation [4.5]), obtaining an estimated parameter vector $\hat{\beta}^1$. In the second step (Step 2), $Y^2_{s,t} = Y_{s,t} - z^1_{s,t}\hat{\beta}^1$ was regressed on $Z^2$, month-of-year and fiscal year dummy variables. The variable $Y^2_{s,t}$ is the natural logarithm of high-quality contracts per youth population purged of the influence of variables in $Z^1$. The Step 2 regression equation is estimated by constraining the effects of Step 1 variables to be their estimated values from Step 1. The Step 1 estimates of $\hat{\beta}^1$ are consistent because by construction the right-hand side variables are uncorrelated with any of the state or time fixed effects.

However, the step-2 estimates will not be consistent (or unbiased) if the variables included in $Z^2$ are correlated with state fixed effects or with time effects. Two observations about these estimates are worth pointing out. First, this two-step procedure makes the best possible use of the data at hand. Second, the variables of greatest policy interest included in the second step are college benefits and enlistment bonuses, both of which vary over time but not within a state. By definition, neither of these variables is correlated with omitted state fixed effects. Furthermore, the possibility that they are correlated with omitted time effects is highly unlikely because dummy variables for each month and fiscal year of the study period have been included in the basic supply model.

Relative military pay can be included in either $Z^1$ or $Z^2$. This variable exhibited considerable variation across states, but displayed little variation over time within states. Estimating the effects of pay in the second step exploits the cross-sectional variation in the data. However, the estimates will be biased if pay is correlated with omitted factors that vary systematically across states. For example, low civilian earnings may indicate low labor force quality, which also might lead to lower recruiting. The estimated elasticities of recruiting with respect to pay were positive and statistically significant. Estimates of pay effects obtained in Step 1 tended to be smaller than estimates obtained when pay is included in the second step. If civilian pay is measured with significant error, fixed-effect estimation leads to downward biased

estimates of pay if it is included in Step 1.[37] Pay was, therefore, included as a variable in Step 2, where it is possible to control for otherwise unobservable components of civilian labor market productivity using information on demographic characteristics such as the percentage of youth population in college and median family income.

### *The Estimates*

Step-1 estimates are shown in Appendix C, Tables C-1 through C-4. Step-2 estimates are shown in Appendix Table C-5 for the Army and Navy, and in Table C-6 for the Air Force and Marine Corps. Because the Services and policy makers are concerned about the possibility that the effectiveness of recruiters declined in the post drawdown environment, tests for changes in the effectiveness of recruiters were carried out by interacting the recruiter-related variables in equation (5.3) with a dummy variable for the period FY 1994-1997. These models are reported in the Appendix tables in columns labeled "Structural Change." The effects of unemployment were allowed to vary between the two periods. The coefficients on advertising were restricted to be the same in both periods because there was insufficient variation in the data to estimate within period effects. Table 5.1 summarizes the empirical results in Tables C-1 to C-6.

### *Effects of Recruiting Resources and Incentive Programs*

#### *Recruiters and Goals*

The first two parts of Table 4.1 summarize the estimated effects of recruiters and goals. Elasticities were computed using formulae provided above and evaluated at the sample average values of goals per recruiter (G/R). The recruiter elasticity estimates indicate that each 10 percent increase in the number of recruiters increases high-quality enlistment by between 3.8 percent and 5.7 percent, depending upon the Service.[38] The table also shows how within-period recruiter productivity differed by Service. The differences between the early period, FY89-93, and the later FY94-97 period are statistically significant as a group at the 0.05 level in all models. The estimated elasticities remained the same or increased for three of the four Services. The Army, however, experienced a 30 percent decline in recruiter productivity.[39]

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[37] See Johnston and DiNardo (1997, pp. 399-402) for a discussion of the consequences of measurement error in fixed effects estimation.

[38] These estimates imply there are diminishing returns to recruiters because enlistments change less than proportionately to a given percent change in recruiters.

[39] There are several possible explanations for the dramatic fall in Army recruiter productivity. Downsizing may have reduced the effectiveness of a recruiting process that is efficient only at a larger scale. The fall in productivity may also be the result of changes made to recruiter incentives in the Success 2000 program. Prior to Success 2000, Army quotas were given to each individual recruiter, and each recruiter was awarded or penalized based on his or her individual productivity in signing recruits. Under Success 2000, goals were assigned at the level of the recruiting station, with much less emphasis on individual productivity. Evaluating the effects of Success 2000 would require detailed data on contract production for each individual recruiter and recruiting station.

**Table 4.1**
***Summary of Estimates: Elasticities and Effects on High-Quality Recruiting***

| *Factor* | *Time Period/ Variable* | *Elasticity/ Effect* | *Army* | *Navy* | *Air Force* | *Marine Corps* |
|---|---|---|---|---|---|---|
| Recruiters | Whole Period | Elasticity | 0.50[a] | 0.57[a] | 0.38[a] | 0.43[a] |
| | FY 1989-93 | Elasticity | 0.55[a] | 0.47[a] | 0.25[a] | 0.42[a] |
| | FY 1994-97 | Elasticity | 0.41[a,1] | 0.64[a,1] | 0.48[a,1] | 0.47[a] |
| Goals | Whole Period | Elasticity | 0.15[a] | 0.41[a] | 0.43[a] | 0.05 |
| | FY 1989-93 | Elasticity | 0.20[a] | 0.50[a] | 0.37[a] | -0.04 |
| | FY 1994-97 | Elasticity | 0.07[a] | 0.37[a] | 0.44[a] | 0.15 |
| Total Advertising | Own-SVC ($) | Elasticity | 0.163[a] | 0.076[b] | -0.013 | -0.065[a] |
| | Own-SVC (Imp) | Elasticity | 0.136[a] | 0.084[a] | 0.014 | -0.051[a] |
| | Joint ($) | Elasticity | -0.006 | 0.000 | 0.024 | 0.027 |
| | Joint (Imp) | Elasticity | -0.009 | 0.002 | 0.027 | 0.022 |
| TV Advertising | Own-SVC ($) | Elasticity | 0.095[a] | 0.050[c] | | -0.070[a] |
| | Own-SVC (Imp) | Elasticity | 0.116[a] | 0.000 | | -0.057[a] |
| | Joint ($) | Elasticity | 0.003 | -0.008 | 0.014 | 0.025[b] |
| | Joint (Imp) | Elasticity | 0.008 | -0.003 | 0.015 | 0.022[b] |
| Non-TV Advertising | Own-SVC ($) | Elasticity | 0.148[a] | 0.047 | -0.013 | |
| | Own-SVC (Imp) | Elasticity | 0.067[a] | 0.081[a] | 0.010 | |
| | Joint ($) | Elasticity | -0.078[a] | 0.039[b] | 0.008 | -0.051[b] |
| | Joint (Imp) | Elasticity | -0.071[a] | 0.033[c] | 0.015 | -0.056[b] |
| Enlistment Bonus | | Elasticity | 0.12[a] | 0.024 | | |
| Educational Benefits | Pct Eligible | Effect | 0.33[a] | 0.18[b] | | |
| | Expected CF | Elasticity | 0.47[a] | 0.23[b] | | |
| Rel Mil Pay | | Elasticity | 1.05[a] | 1.17[a] | 0.67[a] | 0.38[a] |
| Unemployment | Whole Period | Elasticity | 0.26[a] | 0.29[a] | 0.23[a] | 0.28[a] |
| | FY 1989-93 | Elasticity | 0.22[a] | 0.26[a] | 0.19[a] | 0.28[a] |
| | FY 1994-97 | Elasticity | 0.34[a,1] | 0.35[a] | 0.27[a] | 0.30[a] |
| Cross-Service Effect | Whole Period | Elasticity | -0.12[C] | -0.13[a] | -0.08 | -0.27[A] |
| | FY 1989-93 | Elasticity | -0.13[C] | -0.13[a] | -0.07 | -0.31[a] |
| | FY 1994-97 | Elasticity | -0.13[C] | -0.15[a] | -0.07 | -0.18[a] |
| Demographic Factors | Pct QMA | Effect | 0.42[b] | 1.77[a] | 0.28 | 0.19 |
| | Family Income | Elasticity | -0.72[a] | -0.78[a] | -0.62[a] | -0.40[a] |
| | College Attend | Elasticity | -0.87[a] | -1.01[a] | -1.17[a] | -0.89[a] |
| | Pct Veteran | Elasticity | 1.44[a] | 1.48[a] | 0.97[a] | 1.10[a] |
| | Pop Den (x10) | Effect | -0.01[a] | -0.02[a] | -0.01[a] | -0.02[a] |
| | Pct Black | Effect | 0.49[a] | 1.49[a] | -0.19 | 0.33[b] |
| | Pct Hispanic | Effect | 0.57[a] | 1.42[a] | 0.37[a] | 0.52[a] |
| Fiscal Year | 1990 | Effect | 0.093[a] | 0.132[a] | -0.133[a] | 0.132[a] |
| | 1991 | Effect | 0.023 | 0.100[a] | -0.220[a] | 0.122[a] |
| | 1992 | Effect | -0.067[a] | 0.076[a] | -0.178[a] | 0.109[a] |
| | 1993 | Effect | -0.138[a] | -0.091[a] | -0.265[a] | 0.138[a] |
| | 1994 | Effect | -0.201[a] | -0.222[a] | -0.238[a] | 0.144[a] |
| | 1995 | Effect | -0.186[a] | -0.318[a] | -0.217[a] | 0.103[a] |
| | 1996 | Effect | -0.162[a] | -0.278[a] | -0.153[a] | 0.192 |
| | 1997 | Effect | -0.230[a] | -0.353[a] | -0.232[a] | 0.217[a] |

[a] = significant at 1 percent level; [b] = significant at 5 percent level; [c] = significant at 10 percent level.
[1]Later period estimate significantly different from earlier period at 5 percent level.

Expansions in the total recruiting goal are significant and positively related to high-quality enlistment in all Services but the Marine Corps. The whole-period estimates indicate that a 10percent goal increase would expand high-quality enlistments somewhere between 1.5 percent (Army) and 4.3 percent (Air Force). Estimated goal elasticities for the Army and Navy are larger in the early period than the later period, but for the Air Force the opposite was true.

It is important to recognize that high-quality enlistments respond less-than-proportionately to changes in total goal. As a result, if goals were to increase without any other changes, high-quality enlistments would decline as a share of total enlistments. In other words, absent any other changes in recruiting resources, quality must decline as demand (as measured by the total goal) increases.

### *Advertising*

The advertising database described in Chapter 2 consisted of advertising expenditures and impressions by state and month for national advertising media, including television, radio, magazines, newspapers, mailings, and supplemental, as well as local media. A number of important issues arise concerning the specification of the advertising variables in the model. Readers interested in a detailed justification of the variables used in the present study are referred to Appendix D.

This study experimented with several flexible forms of advertising-enlistment supply relationships. One alternative defined advertising variables as the sum of the previous eleven months of advertising expenditure or advertising impressions.[40] Another, less restrictive alternative was based on four lags of advertising expenditure (or impressions) computed from the previous eleven months' expenditures (or impressions). That is, advertising was measured by the variables $\Sigma_{t-1}^{t-3} a_t$, $\Sigma_{t-4}^{t-6} a_t$, $\Sigma_{t-7}^{t-9} a_t$, and $\Sigma_{t-10}^{t-11} a_t$, where $a_t$ is equal to advertising expenditures or impressions in month t. The third most general alternative included advertising in each of the previous 11 months as separate variables in the model. An important and interesting finding of the analysis was that the joint significance of the advertising variables and the long-run elasticities implied by the estimates were almost identical for the three specifications. For simplicity, the estimates based on the first alternative (i.e., the sum of the previous 11 months of advertising expenditure or impressions) are therefore shown in Table 4.1.

Table 4.1 reports advertising elasticities for models based on total advertising dollars or total impressions. Models were also estimated in which advertising entered separately by medium. TV expenditures were relatively large and had sufficient variation to be entered on its own. However, expenditures in many categories were very low or had insufficient variation to allow precise estimation of the effects of advertising. To address this problem, estimation was carried out using a two-medium aggregation consisting of TV advertising and all other advertising.

The estimated total advertising elasticity is positive and highly significant for the Army and Navy, whether based on dollars or impressions. However, the magnitude of the estimate for

[40] Total advertising in the last 12 months less advertising in the current month was used to reduce simultaneity bias.

the Army is sensitive to whether advertising is measured using expenditures or impressions. The estimate based on expenditures is somewhat larger than the one based on impressions (0.163 versus 0.136). The elasticity estimated using impressions is closer to those estimated in previous research. The estimates for the Navy are less sensitive to the definition of advertising, with an elasticity of 0.084 using impressions and an elasticity of 0.076 using expenditures. Both of these estimates are somewhat higher than of most earlier studies.[41]

The elasticity estimate using expenditures is statistically insignificant for the Air Force. The reason for this may be that Air Force advertising expenditures were very low and were flat over time (see Table 2.2). These expenditures may not have reached a threshold level necessary to have an impact on enlistments. The Marine Corps estimate is negative and statistically significant. However, because Marine Corps advertising data cover only about 60 percent of the Marine Corps advertising budget, this result should not receive much weight without further investigation. Finally, Joint-Service advertising is not statistically significant at conventional levels in any models with total advertising. However, the effects of Joint Advertising for the Air Force or Marine Corps are large enough to suggest that with larger budgets, the Joint advertising program may have positive impacts for these two Services.

Both TV and Other advertising, when entered separately, are estimated to have a significant positive impact on Army recruiting. Once again, however, the estimates are sensitive to whether advertising was measured in dollars or impressions. Using expenditures, the TV elasticity estimate is significant at the 10 percent level, but Other advertising has a statistically insignificant effect. Measured by impressions, however, Other advertising enters with a positive and statistically significant coefficient while Navy TV has no effect. Although these estimates indicate that Navy advertising affects high-quality enlistment, it is not possible to identify the productivity of each medium with a high degree of certainty.

The estimated Air Force and Marine Corps elasticities by medium are similar to those obtained for total advertising estimates and require no further discussion. The Joint advertising results for these two Services, however, deserve mention. When separated by advertising medium, the TV elasticity estimates for the Marine Corps and Air Force are positive and statistically significant at the 20 percent level. These results suggest that with larger budgets, the Joint advertising program may well benefit the Marine Corps and Air Force; although, the effects might be on the small side.

### *Incentive Programs*

Two types of variables were used to capture the effects of educational incentives on high-quality enlistment. The first was based on proportions of high-quality recruits – in the case of the Army, the proportion of recruits eligible for ACF, and in the case of the Navy, the proportion of recruits actually receiving NCF. The second was equal to the expected present value of educational benefits (discussed previously in Chapter 2), which is denoted by PVCOL.

***Econometric Issues.*** An unexpected difficulty was encountered in estimating the effects of PVCOL in the Army model. The database for this study initially ran through April 1997. The

[41]See Table B.3. Warner (1991) estimated the total Navy advertising elasticity to be 0.05.

estimated coefficient on PVCOL was positive and statistically significant. When additional data became available – specifically, five additional months were added to the database – the estimated coefficient on PVCOL became statistically insignificant. The most likely explanation for the change in results was the dramatic expansion during the last two quarters of FY97 in enlistment bonuses, both in eligibility and amounts offered. In Chapter 2, it was noted that this expansion corresponded to a severe drop in the percentage of recruits choosing Army College Fund, despite increased ACF present values (see Figures 2.6 and 2.7). To solve this problem, a dummy variable was included in the PVCOL model for the Army, which was set equal to 1 for the period between May and September of 1997, and 0 otherwise.

The second problem concerned enlistment bonuses. In preliminary regression equations for the Army, the contemporaneous expected bonus variable entered with a consistently negative sign. Closer examination revealed that during downsizing the Army reduced the number of skills eligible for EB at a time when recruiting missions were declining and recruiting was simply easier. As it became increasingly difficult to achieve new higher recruiting missions later on, the Army later expanded the number of skills eligible for bonuses. The policy of expanding bonuses during tough times generates a negative relationship between high-quality enlistment and EB, generating what econometricians call "endogeneity" or "simultaneous equations bias."

A standard solution is to find one or more proxy variables for the problem variable (here, EB) that are not affected by the degree of recruiting difficulty at the same precise point time. These proxy variables are then used to predict EB, and the predicted value of EB is then entered in the original regression model. This is called the method of instrumental variables. In the present case, good instruments for EB in the current month were provided by lagged values of recruiting shortfalls (defined as the difference between the contract mission in a month and the number of contracts achieved). In particular, the expected bonus variable in month t was regressed on the shortfalls of the nine previous months.

Attempts were made to determine whether simultaneity was also a problem in the Navy models. However, the instrumental variable technique did not succeed in producing a better estimate of the impact of enlistment bonuses than the actual contemporaneous expected EB amount. Therefore, the actual EB variable was entered in the regression models.

***Estimated Effects of College Benefits.*** The proportion eligible for ACF exerts a positive and statistically significant effect on Army high-quality enlistments. The coefficient, 0.327, indicates that Army high-quality enlistments would expand by about 3.3 percent if ACF eligibility were to rise by 10 percentage points. To put this estimate in perspective, note that about 52 percent of Army high-quality recruits were eligible to receive the ACF in FY97. Although it is risky to predict too far away from the mean, this estimate suggests that 17 percent (3.3 percent x 52 percent) of Army high-quality recruits, or 8,154, would not have joined in the complete absence of ACF in FY 97. About 14,000 high-quality recruits actually received ACF in FY97. These calculations thus suggest that more than half of them would not have enlisted had ACF not been offered.

Estimates based on the expected present value of college benefits (PVCOL) also suggest a powerful effect of education benefits on high-quality enlistment. The estimated coefficient of PVCOL, 0.47, is the ACF elasticity of high-quality enlistments with respect to PVCOL, and

indicates that a 10 percent increase in PVCOL would lead to about a 5 percent increase in high-quality enlistments. The average FY97 value of PVCOL, expressed in FY98 dollars, was $10,233. This estimate is an eligibility-weighted average of the present value of ACF benefits and the present value of MGIB benefits. The present value of the MGIB benefits was $7,505 in FY97. Eliminating the ACF entirely and providing only the MGIB college benefits is therefore estimated to reduce high-quality enlistments by about 14.6 percent (ln(7,505) minus ln(10,233), multiplied by 0.47). This corresponds in FY97 to 7,000 fewer high-quality enlistments.

Turning to the Navy, the estimated effects of both NCF receipt and PVCOL were positive and statistically significant. The estimated coefficient on the percent taking NCF was 0.184, and implies that each 10 percent increase in NCF positions leads to a 1.8 percent increase in high-quality enlistments. About 29 percent of Navy high-quality recruits – about 9,200 -- received NCF in FY97. The estimates imply that eliminating NCF altogether would have reduced Navy high-quality enlistments by 5.3 percent (0.184 times 0.29) – 1,702 fewer high-quality recruits in FY97 out of total of 32,119. The estimated coefficient on PVCOL was 0.230, implying that a 10 percent increase in PVCOL would increase enlistments by 2.3 percent. According to this estimate, eliminating NCF would have cost the Navy 1,629 high-quality recruits in FY97 – similar to the estimate based on NCF openings.

The estimated effects of college benefits were much higher for the Army than for the Navy. This finding is consistent with earlier estimates by Warner (1990). One possible explanation is that because ACF recipients tend to serve shorter terms of enlistment, they receive college benefits sooner than NCF recipients. For example, in FY97 the average enlistment length among NCF recipients was nearly 5 years, compared to just 3.5 years for ACF recipients. The Army, therefore, would appear to be more attractive to individuals motivated to join the military because of the availability of college benefits.

***Estimated Effects of Enlistment Bonuses.*** The estimated effects of expected enlistment bonuses are positive and statistically significant for Army enlistment models but not for the Navy. The EB elasticity for the Army is 0.12 in one model, 0.14 in the other, and implies about a 1.3 percent increase in high-quality enlistment for each 10 percent increase in the expected bonus amount. By contrast, the estimated EB elasticity for the Navy is only about 0.03, and is statistically insignificant.

Although there are apparently no market expansion effects of the Navy's EB program, the Navy EBs effectively induce recruits to enlist for longer initial terms of enlistment and channel them into critical ratings. The term- and skill-channeling effects of enlistment incentives are discussed below in Chapter 6.[42]

### *Other-Service High-quality Recruiting Effort: Spillover Effects*

In order to determine whether increased enlistments in one Service are achieved at the expense of enlistments in other Services, the regression models for each Service contained a

[42] One aspect of the Navy's bonus program deserves mention. The Navy varies bonuses by season of entry, paying larger bonuses to Winter and Spring entrants than to Summer and Fall entrants. The purpose of this policy is to encourage recruits to enter in less popular months so that the Navy can smooth its training pipeline. Analysis of the season-channeling effects of Navy bonuses is not presented here, but a memo is available upon request.

variable measuring the intensity of other-Service high-quality recruiting effort (see equation 4.3). The estimated coefficients on these variables were negative and statistically significant in three of the four Services (the Air Force was the exception), indicating the presence of negative inter-Service effects. Thus, simultaneous increases in recruiting resources by all four Services have a smaller impact on DoD-wide enlistments than would otherwise be apparent from an analysis of just a single Service.

To illustrate the magnitude of the spillover effect, suppose that the four Services expand their recruiter forces simultaneously by 10 percent. The average elasticity of own-Service high-quality enlistments with respect to own-Service recruiters was about 0.5, which implies that enlistments would rise by about 5 percent. The average cross-Service elasticity was -0.13, which means that DoD-wide enlistments would increase by only 4.4 percent (87 percent of 5 percent) due to a 10 percent expansion in recruiters, not 5 percent. Although not large in magnitude, the negative cross-Service relationships estimated here are a matter of concern to policymakers.

## *Economic Factors*

### *Relative Military Pay, Unemployment, and Population Density*

The estimated elasticities of high-quality enlistments with respect to pay and unemployment were positive and statistically significant at the 1 percent level. Each 10 percent increase in relative pay is predicted to increase Army high-quality enlistments by 10.5 percent, Navy enlistments by 11.7 percent, Air Force enlistments by 6.7 percent, and Marine Corps enlistments by 3.8 percent. These estimates are well within the range of those from previous studies (Table B.2).

Each 10 percent increase in the unemployment rate is predicted to increase high-quality enlistments by between 2.3 percent and 2.9 percent. When the study period is divided in two the estimated unemployment elasticities are slightly higher for the later (FY94-97) period. However, only the Army unemployment elasticity for this period is statistically different from zero.

Population density might be expected to influence high-quality enlistment supply to the extent that more densely populated states offer more attractive civilian job opportunities. The Step-2 estimates indicate that high-quality enlistments were indeed lower in states with higher population (youth 17-21 years who were high school senior or better) per square mile.

How much can current recruiting challenges be attributed to lower unemployment? The unemployment rate fell from nearly 8 percent in July 1992 to 4 percent in December 1999, a decline of about 50 percent. Based on the FY94-97 period average elasticity of 0.32, high-quality enlistments declined about 16 percent (50 percent multiplied by 0.32). DoD-wide high-quality enlistments in FY97 were 134,991; had unemployment been at its FY92 level, high-quality enlistments would have been about 21,600 recruits higher.

### *Median Family Income*

State median family income is included in the supply models to control for a number of effects. Youth from families with higher incomes have greater capacity to finance college

education, and for this reason may be less inclined to serve. Median family income is also strongly positively related to parents' education levels, which was seen in the propensity analysis (Chapter 3) to be strongly negatively correlated with youth propensity. As expected, the relationship between high-quality enlistments and median family income was strongly negative. Depending on Service, each 10 percent increase in median family income is associated with a fall in high-quality enlistment of 4.0 percent-7.8 percent.

### *Demographic Factors*

#### *College Attendance*

The Step-2 models included the logarithm of the fraction of a state's high school graduate population, aged 17-21, enrolled in college. This variable measures the likelihood that a high school graduate will attend college in the next four years. Estimates of its' effects are reported in Tables C.5 and C.6, and can be interpreted as elasticities of high quality enlistment with respect to college attendance. Each 10 percent increase in college attendance is estimated to reduce high quality enlistments by between 8.9 percent (Marine Corps) and 11.7 percent (Air Force). Using FY97 enlistment shares for the four Services, a 10 percent increase in college attendance is estimated to reduce total DoD high quality recruiting by 9.6 percent.

To what extent does the increase in college attendance explain recent recruiting challenges? In Chapter 2, it was seen that the fraction of youth going to college rose from 0.56 in 1987 to 0.62 in 1997, an increase of 11 percent. The results here imply that DoD enlistments in FY97 would have been about 9.6 percent (14,300) higher had the percentage of high school graduates proceeding to college remained at its FY87 level.[43]

#### *Racial Composition and Percent Qualified Military Available*

The Step-2 regression models include the proportions of each state's youth population that were Black and Hispanic respectively. These demographic variables will tend to pick up otherwise unmeasured variations in both supply (attitudes, civilian labor market opportunities) and demand (qualifications). High-quality enlistments in the Army and Navy are significantly higher in states with higher percentages of Blacks and Hispanics. The effects of race are especially pronounced for the Navy. Enlistments in the Air Force and Marine Corps are also positively related to percent Hispanics. However, Air Force high-quality enlistment was negatively related to percent Black, and there was no evidence of any effect of percent Black on high-quality enlistment in the Marine Corps.

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[43] To evaluate the plausibility of these estimates, consider the following back-of-the-envelope calculation. DoD FY97 high-quality enlistments were 134,646. According to the Woods & Poole population data, there were 6.3 million college students in the United States in 1997, or 47 percent of the total youth population of 13.4 million (excluding high school dropouts and GED graduates). The propensity to enlist out of the total population was about 1 percent (136,646 divided by 13.4 million), and the propensity to enlist out of the non-college population was about 1.9 percent (134,636 divided by 7.1 million non-college population). Holding constant the propensities to enlist, a 10 percent increase in the college population would reduce high-quality enlistment by 0.019 times 630,000 = 11,970, or by about 9 percent of FY97 high-quality enlistments. The econometric estimates of the impact of college attendance are close to this back-of-the-envelope calculation.

Percent QMA is the estimated proportion of the 17-21 year old population that is qualified to join the military as high-quality recruits. The QMA variable is positive in all four models, but significant only in models for the Army and Navy. One might worry that the effects of percent QMA are understated because the demographic variables in the supply models, especially racial composition, are highly correlated with percent QMA. However, removing the demographic variables did not increase the size or statistical significance of percent QMA.

### *Adult Influencers: Percent Veterans*

Veterans who served in the military are a potentially important source of influence on the enlistment decision. The percentage of each state's population of men (age 35 old and over) who had ever served in the military ( percent VETS) was computed using data from the Current Population Survey.[44] Because there is a great deal of random noise in monthly frequencies, annual averages by state were used rather than monthly averages. Given limited time-series variation, percent VETS was included in the Step-2 models.

Between 1987 and 1997, percent VETS fell from 29 percent to 25 percent. Estimates of the effects of this decline by Service imply that DoD enlistments were about 19 percent lower than they would have been had the veteran population remained unchanged over the past decade. The estimated effects are consistently positive, large and highly significant, especially for the Army and Navy. Specifically, a 10 percent decrease in the size of the veteran population would reduce high-quality enlistment by 14.4 percent in the Army and by 14.8 percent in the Navy according to the estimates. The DoD-wide average estimate is 13.2 percent. The findings further suggest that enlistments in all four Services respond more than proportionately to a given change in the percent VETS population variable. These effects are quite large, however, and may overstate the true effect of influencers. The effect of veteran influencers needs more study.

## *Unexplained Trends In Enlistments*

The Step-2 models included fiscal year variables to account for the effects of omitted time-related factors on high-quality enlistment supply.[45] The coefficient estimates of these variables measure percent differences relative to FY89. The results in Table 4.1 show that even after accounting for the health of the civilian economy, changes in population composition, and changes in the levels of recruiting resources, there remained a strong, negative trend in high-quality enlistments since FY92 for the Army, Navy, and Air Force. In spite of this mounting difficulty, the Services were able to meet their recruiting missions through FY97. In FY98 however, the Navy fell 7,000 recruits short of its goal, and the Army and Air Force fell short of their recruiting missions in FY99. There is, by contrast, a positive unexplained trend in Marine Corps recruiting. In this light, it is not surprising that the Marine Corps has not experienced recruiting shortfalls in the 1990s.

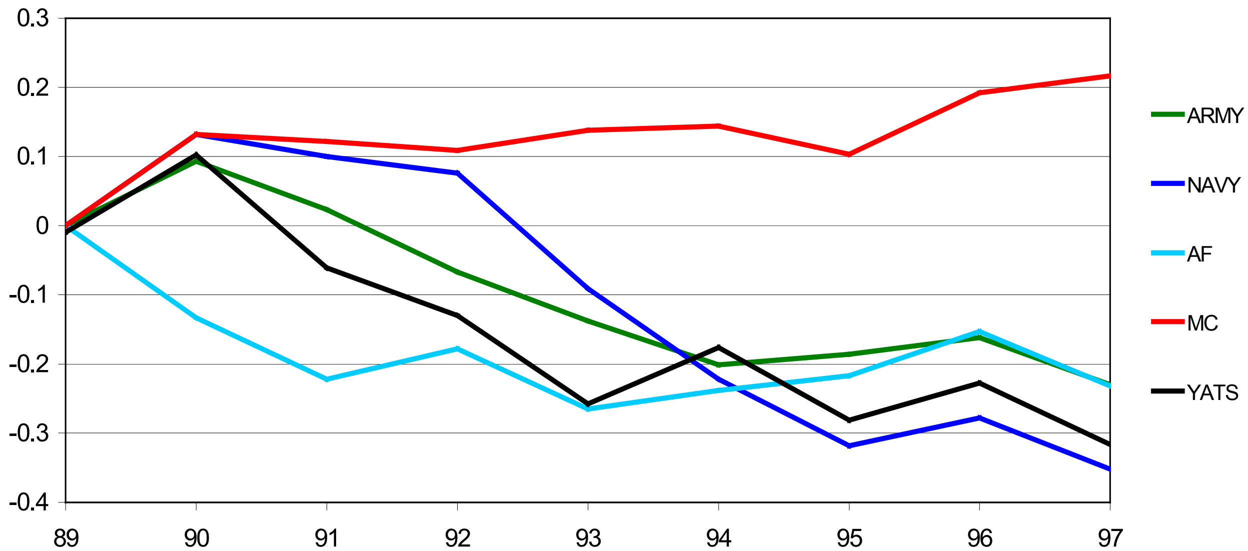
The negative unexplained trend in Army, Navy, and Air Force high-quality enlistments could be the result of a number of factors on the demand or supply sides of the enlistment process. One influence from the demand side could be a decline in recruiter productivity related

[44] The veterans population was limited to males 35 years of age or older on the grounds that the most important influencers will tend to be the fathers and grandfathers of the current youth generation.
[45] Recall that time effects were removed from the Step 1 estimation by the two-way differencing.

to factors such as changes in recruiter incentive plans or the number of recruiting offices. Beginning in FY94, large numbers of recruiting facilities were closed across the U.S. However, econometric estimates of the negative effects of station closings by Hogan and Mahay (1999) show that this change cannot explain the residual trend documented in Table 4.1.

In the absence of an obvious negative shock to recruiter productivity, the supply side of the equation must be considered -- specifically the effect of changing preferences of youth on enlistment supply. Findings of the analysis of YATS described in Chapter 3 included a large decrease in propensity to join the military among high school seniors. Based on the fiscal year dummy variables, Figure 4.1 shows the unexplained decline in average male propensity for military Service relative to 1989. The unexplained negative trends in recruiting for the Army, Navy, and Air Force are also displayed along with the positive Marine Corps trend. For the period FY94-97 the unexplained decline in Army, Navy, and Air Force high-quality enlistments is very close to the decline in propensity. While this does not establish cause and effect, it strongly suggests that recent recruiting challenges for the Army, Navy, and Air Force may be related to the drop in propensity. This finding also suggests that additional research on the link between high quality enlistment supply and youth propensity could prove fruitful.

**Figure 4.1**
***Normalized YATS Propensity and Unexplained Trend in High-Quality Recruiting***




### ***Cost-Effectiveness of Pay, Recruiting Resources and Incentive Programs***

This section presents estimates of the cost-effectiveness of alternative policies for attracting high-quality recruits. The econometric estimates described above were used to calculate the cost of recruiting an additional high-quality recruit for each recruiting resource – what economists call the marginal cost of one additional recruit. Estimates of these marginal costs are contained in Table 4.2.

***Pay***. The *annual* basic pay cost of hiring one additional recruit in FY99 is given simply by average first-term basic pay ($16,328 per year). This is the *average* cost (AC) of hiring one

additional recruit by increasing military pay. However, the *marginal* cost of recruiting high-quality recruits with higher pay alone is given by the formula AC($1+1/\eta_S$), where $\eta_S$ is the (estimated) elasticity of high-quality enlistment supply with respect to relative military pay from Table 4.1. The marginal cost of attracting one additional recruit by raising military pay ranges from $30,000 for the Navy to $59,000 for the Marine Corps.[46]

**Table 4.2**
***Marginal Cost of High-Quality Recruits by Policy Option ($1,000)***

| *Option* | *Army* | *Navy* | *Air Force* | *Marine Corps* |
|---|---|---|---|---|
| Pay | $32.0 | $30.0 | $40.8 | $59.0 |
| Recruiters | $12.5 | $8.4 | $3.4 | $9.5 |
| Advertising ($): | | | | |
| Total | $9.0 | $7.7 | | |
| TV | $9.3 | $7.3 | | |
| Other | $3.8 | $4.7 | | |
| Advertising (Imp): | | | | |
| Total | $10.7 | $7.0 | | |
| TV | $7.0 | - | | |
| Other | $8.4 | $2.7 | | |
| College Fund | $5.5 | $12.8 | | |
| Enlistment Bonus | $13.9 | ∞ | | |

***Recruiters***. The marginal cost of attracting an additional recruit by increasing the size of the recruiter force ranges from $3,400 in the Air Force to $12,500 in the Army.[47] The estimates are based on the assumption that a recruiter costs $45,000 per year -- $35,000 in pay and benefits, plus $10,000 in support costs. Recruiter effect estimates are for the FY1994-97 period in Table 4.1. The marginal cost is lowest for the Air Force recruiters because they sign a larger number of contracts on average than recruiters in the other Services. The high marginal cost for the Army is a result of the relatively low responsiveness of high-quality enlistments to recruiters (see Table 4.1).

***Advertising***. The estimated marginal cost of hiring an additional recruit through increased advertising is sensitive to whether advertising is measured by expenditures or by impressions. Regardless of the definition of advertising, the cost-effectiveness of advertising is much greater than that of pay. Advertising appears to be more cost-effective than recruiters.

***College Benefits***. Each year the DoD Actuary estimates the per-capita cost of the college fund programs. Per-capita cost is defined as the expected present value of the future liability to DoD of a college fund recipient who enlists for a given term. These estimates are based on the

[46] These estimates may seem high, but it must be kept in mind that pay increases are received by everyone, including recruits who would have enlisted without the pay increase (about 140,000 in FY97).
[47] These marginal costs estimates are calculated using the formula MC = $45,000 (R/HQ) ($1/\eta_R$), where $\eta_R$ is the elasticity of high-quality enlistments with respect to recruiters; $45,000 (R/HQ) is the average recruiter cost of HQ enlistments (the recruiter budget divided by the number of HQ recruits).

probability that a college fund recipient will complete his or her term of enlistment (and hence qualify for the benefit), as well as the probability that the recipient uses the benefit after leaving the military.[48]

The Services finance only the kicker portion of college fund programs; the Montgomery GI Bill portion of the college benefit program is funded through the Veteran's Administration. The FY97 cost of the kicker programs was computed as a weighted average of the Actuary's per-capita cost estimates for various combinations of enlistment term and kicker amount. Weights were based on the number of FY97 college fund enlistees in each combination.[49] The total cost of the Army kicker program was $38.8 million in FY97; the cost of the Navy kicker program was $20.4 million.

The estimated marginal cost of attracting one additional recruit through Army College Fund is $5,500. The figure for the Navy College Fund is $12,750.[50] The ACF marginal cost is lower than NCF because Army recruits are more sensitive to college benefits than Navy recruits. Compared to the other resources in Table 4.2, the ACF is very cost effective. Even if the ACF supply elasticity were only half as large as the estimate in Table 4.1, the ACF would still be cost-effective compared with Army recruiters and about as cost-effective as Army advertising. The NCF program is less cost effective than Navy recruiters and advertising, but is much less costly than would be a general pay increase. In addition, the NCF serves as a useful policy tool for channeling recruits into specific skill, or ratings, and years of enlistment obligation (i.e., terms-of-enlistment).

***Enlistment Bonuses***. In FY97, 15,055 of the 48,000 Army high-quality recruits received an EB. The average EB was $5,840, and the total EB budget was therefore approximately (15,055 times $5,840) $87.9 million. The bonus elasticity estimate for the Army in Table 4.1 implies that doubling the average EB (and hence doubling the EB budget) to $11,680 would increase enlistments by 5,760 (0.12 times 48,000). But doing so would have increased the FY97 bonus budget by $80 million, which implies the marginal cost of enlistment bonuses is $13,900.

[48] See Report of the DoD Actuary, *Valuation of the Department of Defense Education Benefits Fund As of September 30, 1998*.

[49] In FY97, the average per-capita cost of the ACF program was $2,772; the average per-capita cost of the NCF program was $2,118. The per-capita actuarial cost of the Navy program is lower because NCF recipients enlist for longer terms than ACF recipients (5 years versus 3.5 years).

[50] Recall that the conservative supply estimates implied that 7,000 of the 14,000 ACF recipients, and 1,600 of 9,200 NCF recipients would not have enlisted in absence of those programs. The marginal cost of the ACF program in FY97 was $38.8 million/ 7,000 = $5,500, and the marginal cost of the NCF program was $20.4 million/1,600 = $12,750.

# CHAPTER 5

# ANALYSIS OF DEP ATTRITION

### *Overview*

Most recruits do not enter military service immediately upon signing an enlistment contract. Instead, they are assigned an expected ship-to-active-duty date and enter the Delayed Entry Program (DEP) for up to12 months. During the period FY87-97, time in DEP averaged about 4 months. However, between 10 percent and 20 percent of individuals in DEP attrite – that is, leave the program and do not enter the military. Some recruits drop out of DEP because they change their mind about serving, while others are separated involuntarily for drug use or other infractions. This chapter examines the factors that determine DEP attrition, focusing on the effects of enlistment incentives.

Some DEP losses are inevitable, and even desirable to the extent that it is efficient for individuals who are poorly suited for military service to choose other occupations.[51] However, higher DEP loss rates make it more difficult for the Services to evaluate and manage their recruiting effort, manpower levels, and manpower needs. The higher the rate of DEP attrition, the greater the number of gross contracts the Services must produce in order to deliver a given number of recruits to basic training.

Figure 5.1 shows the rate of DEP attrition by Service for FY87-96.[52] DEP attrition has risen steadily since FY87 for the Services. Starting at 10.4 percent in FY 87, DEP attrition for the Army increased to 19 percent by FY96. Navy DEP attrition followed a similar pattern, rising from 10.6 percent to 17.2 percent over the same period. Marine Corps DEP attrition rose from about 18 percent to 23 percent over this period. Only the Air Force has not recently experienced a rise in DEP losses.

### *Determinants of DEP Attrition*

#### *Economic Factors*

Recruits leave the DEP for a variety of reasons. This section focuses on the role economic factors play in the decision to leave the DEP prior to shipping to active duty.

***Civilian Labor Market Alternatives***. A recruit may use a military job offer as insurance against poor civilian job prospects in the future, and hence be uncertain about joining the military in the first instance. For example, if a recruit receives a better civilian job offer than anticipated after signing a contract, or if a better offer is expected to arrive shortly, he/she may drop out of DEP. When the economy is strong and unemployment low, recruits are more likely to receive attractive civilian job offers while in DEP and may therefore leave the DEP before accessing into

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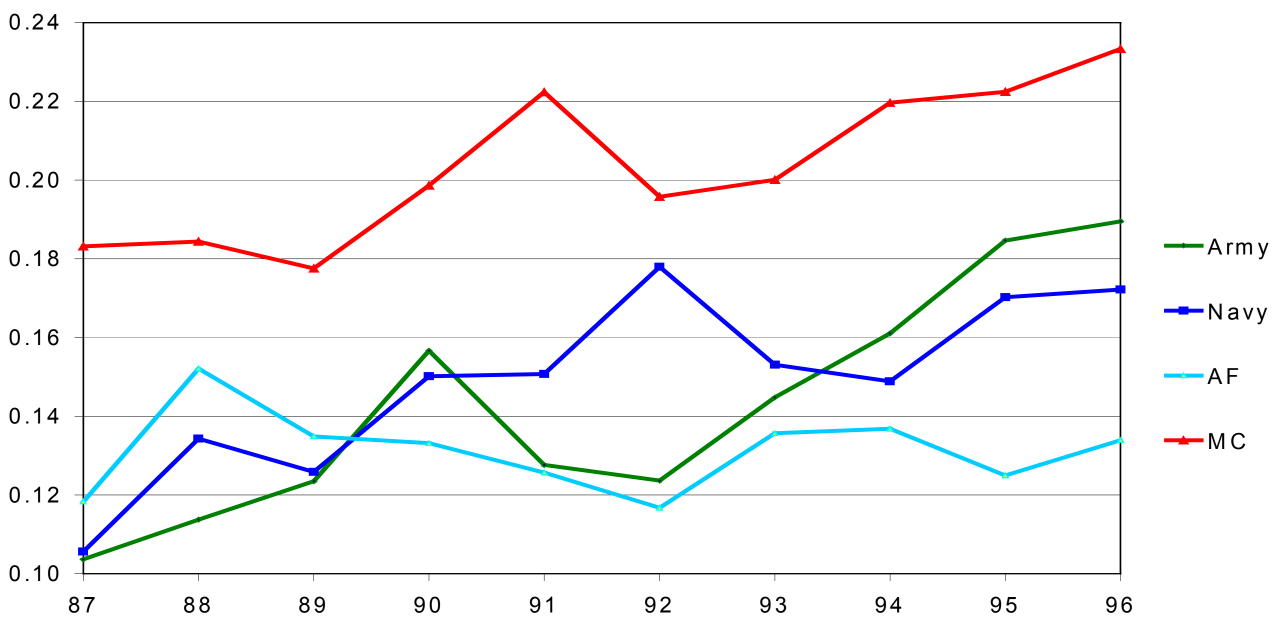
[51] The efficiency is on both sides of the market. The Services gain because their resources are not used training individuals with lower motivation or ability.

[52] These rates were computed using data from MEPCOM, which covered the period through FY97. Recruits must be followed for up to one year – the maximum stay in DEP – to determine their final status.

the military. For this reason, DEP attrition might be expected to be higher the lower the unemployment rate. On the other hand, during periods of high unemployment, recruits who enlist because of economic distress may have relatively low propensity for military service. Therefore, they may be more likely to regret their decisions and hence more likely to leave DEP before accessing. For this reason, higher DEP attrition could occur at higher rather than lower unemployment rates. Given this ambiguity, the direction of effect of the civilian economy on DEP losses, as represented by the unemployment rate, could be positive or negative.

**Figure 5.1**
***DEP Losses as a Fraction of Total Contracts***




***Enlistment Incentives***. An important question for this study is the role played by enlistment incentives in the decision to leave the DEP. Enlistment incentives increase the relative payoff to military service may therefore result in lower DEP losses. However, there is a selectivity issue that may have the opposite effect. Recruits who receive an enlistment incentive may have, on average, less of a preference for military service than recruits who do not receive incentives, and hence may be more likely to drop out of DEP. Selectivity refers to the systematic difference in unobserved propensity between these two categories of recruits. The question of whether bonuses and college benefits reduce or increase DEP attrition can only be answered by empirical research.

### *Expected Time in DEP*

The longer recruits remain in DEP, the more likely they are to drop out. There are two reasons this may happen. First, the longer the time in DEP, the more likely it is that unexpected events can occur that cause the recruits to rethink their decisions to join the military. For example, a competitive civilian job offer is more likely as the time spent in DEP increases. Secondly, recruits who are less certain of their decisions at the time they sign a contract may schedule longer times in DEP to allow more time for a final decision.

### *Years of Service*

If recruits who sign contracts with longer years of obligated service (YO) have a stronger commitment to military service, DEP attrition among this group should be lower than among those with shorter YOs. Enlistment incentives could reinforce this relationship if they also enlisted for longer YOs. But if recruits who sign longer contracts do so *only* because of enlistment incentives, those with shorter YOs might be *less* likely to attrite from DEP.

### *Demographic Characteristics*

Race, gender, AFQT score, marital status, and educational attainment are all factors potentially related to the likelihood of DEP attrition. For example, if Black and Hispanic recruits have less attractive civilian alternatives than Whites, they would be less likely to receive better civilian offers between the time of contract and accession. In this case DEP loss rates would be lower for Black and Hispanic recruits. In terms of educational attainment, prospective recruits who are predisposed to military service would be more likely to sign an enlistment contract during their senior year in high school. In this case, DEP loss rates would be lower for seniors than high school graduates and college students.

Recruits with dependents may be less likely to reevaluate a decision to join the military and hence less likely to leave the DEP. Attrition from the DEP would then be lower for married recruits than for single recruits. However, married recruits may be more likely to use a military job offer as insurance against unforeseen adverse changes in the civilian job market. This could result in a higher DEP loss rate for married recruits.

High-quality recruits are more likely to receive a better civilian offer between the time of contract and accession. This would imply a higher rate of DEP attrition for high-quality. However, high-quality recruits are also more likely to receive a better civilian offer before they sign a contract, and typically receive better military offers. For these reasons, DEP losses of high-quality recruits would be lower. The relationship between high-quality and DEP attrition could therefore be positive or negative.

## *Empirical Results*

Probability (i.e., Probit models) of DEP attrition were estimated for the Army and the Navy. The database includes 371,661 records from the Army's EAF database for FY94-98, and 250,527 records from matched Navy -- MEPCOM) data for FY93-97.[53] In addition to the demographic and incentive variables discussed above, the models also included fiscal year dummy variables. A (dummy) variable for high quality recruits was multiplied times (i.e.,

[53]The MEPCOM database contains information on all individuals who signed enlistment contracts between FY 1987-97. In principle, models of DEP attrition could be estimated with data from earlier periods and for all four Services. However, MEPCOM contract records do not contain the expected accession date, so it is impossible to determine how long an individual expected to be in the DEP at the time of contract. The matched Navy-MEPCOM file and Army EAF files did, however, contain the initial expected accession date needed to determine expected time in DEP. The EAF and matched Navy-MEPCOM files also contain information on enlistment incentives unavailable on the MEPCOM files.

interacted with) in-school status to allow for different effects between low and high-quality recruits of being in school at the time of entry into DEP.

The models also included dummy variables for 2YO, 3YO, 5YO, and 6YO enlistment terms. Estimates of the effects of term of enlistment measure the difference in probability of DEP loss relative to the 4YO term of enlistment. Variables indicating receipt of ACF, NCF and EB were interacted with the YO term variables to allow for incentive effects that vary with the length of the enlistment. The estimates of these interaction effects show the impact of enlistment incentives on DEP attrition within YO categories.

Table 5.1 displays the Probit model estimates of DEP attrition for the Army and Navy. Column (5) shows the marginal effect of each variable on the probability of DEP attrition, evaluated at the mean attrition rate.

***Civilian Economy***. Higher rates of unemployment were associated with lower DEP loss rates. Over a typical business cycle, the unemployment rate can change by 3 percent-4 percent. The estimates in Table 6.1 indicate DEP attrition could fall by 1 percent to 2.4 percent from business cycle peak to trough. A related finding is that recruits from states with denser populations are more likely to leave the DEP prior to accession. This is consistent with the effects of unemployment because states with denser populations also have better job markets than rural states. However, the effect of relative military pay was precisely the opposite; higher relative military pay (equivalently, lower relative civilian pay) was associated with *higher* DEP losses for both the Army and the Navy. The explanation for this seemingly paradoxical finding is unclear. Further research is necessary to understand this effect of pay.

***Enlistment Incentives***. For a given YO, receipt of an enlistment incentive is associated with a lower probability of DEP attrition. For example, Army 2YO and 4YO recipients of the ACF were less likely to leave the DEP. Although the effects of the ACF among 5YO and 6YO were also negative, they were not significant.[54] DEP attrition for the Navy was significantly lower among 4YO, 5YO and 6YO recruits who received the NCF than those who did not. Attrition differences between EB recipients and non-recipients were similar to those of ACF and NCF. For both the Army and Navy, 5YO and 6YO recipients of EBs with 5YO and 6YO terms of service had lower DEP attrition rates than their counterparts who didn’t receive a bonus to enlist.

***Time in DEP***. The estimates show that DEP attrition is higher the longer the contracted time in DEP, and they are highly significant in a statistical sense. Each additional month in DEP increases the probability of attrition by 2.3 percent for the Army and 2.6 percent for the Navy. Compared to direct accessions, time in DEP of 4 months increases the probability of DEP attrition for the Army by 9.2 percent and 10.4 percent for the Navy.

***Demographics***. Demographic characteristics of recruits also affect the rate of attrition from the DEP. The effects of marital status differed between the Army and Navy. Married recruits were 6.4 percent less likely to leave the DEP for the Army than single individuals. By contrast, married recruits in the Navy were 2.4 percent more likely to drop out of the DEP.

[54] The lack of significance could be due to the relatively low fraction of 5YO and 6YO recruits who received ACF.

Females in both Services were *much* more likely to leave the DEP than males. And Nonwhite recruits had lower DEP attrition rates than White recruits.

The effect of being in school differed between the Army and Navy. High-quality recruits in school were more likely to leave the Army DEP, but *less* likely to leave the Navy DEP. High-quality recruits who were not in school at the time they signed contracts were less likely to leave the Army and Navy DEP. High-quality status interacted negatively and strongly with in-school status for both Services, confirming the hypothesis that high school seniors that signed a contract and enter the DEP had a stronger sense of commitment to military service.

DEP attrition is negatively related to term of service. For the Navy, DEP attrition of 3YO enlistments is higher than that of 4YO enlistments. DEP attrition is lower however for 5YO and 6YO enlistment terms. The findings for the Army are similar.[55]

[55] Although the point-estimates for the Army imply lower DEP attrition among 5YO than among 6YO recruits, the difference between the two is statistically insignificant; any confidence interval of reasonable size would include both positive and negative values of this difference.

**Table 5.1**
***Probit Models of DEP Attrition, Army and Navy***

| | *Army* | | | | | *Navy* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *Variable* | *Coeff.* | *Std. Error* | *T-Stat* | *Signif. Level* | *Effect* | *Coeff.* | *Std. Error* | *T-Stat* | *Signif. Level* | *Effect* |
| Intercept | -1.1494 | 0.0531 | -21.7 | 0.000 | | -1.3672 | 0.0646 | -21.2 | 0.000 | |
| Time In DEP | 0.0886 | 0.0011 | 82.8 | 0.000 | 0.023 | 0.1050 | 0.0011 | 92.3 | 0.000 | 0.026 |
| Married | -0.2452 | 0.0081 | -30.2 | 0.000 | -0.064 | 0.0981 | 0.0174 | 5.6 | 0.000 | 0.024 |
| Male | -0.2730 | 0.0061 | -45.1 | 0.000 | -0.071 | -0.3125 | 0.0075 | -41.8 | 0.000 | -0.077 |
| Black | -0.0208 | 0.0062 | -3.4 | 0.001 | -0.005 | -0.0577 | 0.0086 | -6.7 | 0.000 | -0.014 |
| Hispanic | -0.0854 | 0.0099 | -8.6 | 0.000 | -0.022 | -0.0027 | 0.0111 | -0.2 | 0.806 | -0.001 |
| Other | -0.0683 | 0.0129 | -5.3 | 0.000 | -0.018 | -0.0292 | 0.0138 | -2.1 | 0.034 | -0.007 |
| HQ | -0.0326 | 0.0081 | -4.0 | 0.000 | -0.009 | -0.0278 | 0.0091 | -3.1 | 0.002 | -0.007 |
| In School | 0.0296 | 0.0102 | 2.9 | 0.004 | 0.008 | -0.0725 | 0.0113 | -6.4 | 0.000 | -0.018 |
| HQ In School | -0.0498 | 0.0109 | -4.6 | 0.000 | -0.013 | -0.0370 | 0.0129 | -2.9 | 0.004 | -0.009 |
| FY94 | … | … | … | … | … | 0.0680 | 0.0103 | 6.6 | 0.000 | 0.017 |
| FY95 | 0.0273 | 0.0082 | 3.3 | 0.001 | 0.007 | 0.1084 | 0.0107 | 10.2 | 0.000 | 0.027 |
| FY96 | 0.0571 | 0.0082 | 6.9 | 0.000 | 0.015 | 0.1069 | 0.0107 | 10.0 | 0.000 | 0.026 |
| FY97 | 0.0627 | 0.0086 | 7.3 | 0.000 | 0.016 | 0.1111 | 0.0123 | 9.0 | 0.000 | 0.027 |
| FY98 | 0.1465 | 0.0093 | 15.7 | 0.000 | 0.038 | … | … | … | … | … |
| YOS2 | 0.2003 | 0.0521 | 3.8 | 0.000 | 0.052 | … | … | … | … | … |
| YOS3 | -0.0197 | 0.0077 | -2.6 | 0.010 | -0.005 | 0.0480 | 0.0096 | 5.0 | 0.000 | 0.012 |
| YOS5 | -0.0376 | 0.0125 | -3.0 | 0.003 | -0.010 | -0.0144 | 0.0112 | -1.3 | 0.199 | -0.004 |
| YOS6 | -0.0308 | 0.0123 | -2.5 | 0.012 | -0.008 | -0.0421 | 0.0159 | -2.6 | 0.008 | -0.010 |
| CF-2YO | -0.1300 | 0.0530 | -2.5 | 0.014 | -0.034 | … | … | … | … | … |
| CF-3YO | 0.0359 | 0.0118 | 3.0 | 0.002 | 0.009 | 0.0042 | 0.0257 | 0.2 | 0.870 | 0.001 |
| CF-4YO | -0.0889 | 0.0104 | -8.6 | 0.000 | -0.023 | -0.0219 | 0.0128 | -1.7 | 0.086 | -0.005 |
| CF-5YO | -0.0181 | 0.0346 | -0.5 | 0.601 | -0.005 | -0.0756 | 0.0314 | -2.4 | 0.016 | -0.019 |
| CF-6YO | -0.0549 | 0.0560 | -1.0 | 0.327 | -0.014 | -0.0824 | 0.0234 | -3.5 | 0.000 | -0.020 |
| EB-3YO | 0.0968 | 0.0214 | 4.5 | 0.000 | 0.025 | … | … | … | … | … |
| EB-4YO | 0.0049 | 0.0097 | 0.5 | 0.611 | 0.001 | … | … | … | … | … |
| EB-5YO | -0.0445 | 0.0288 | -1.5 | 0.123 | -0.012 | -0.0449 | 0.0200 | -2.3 | 0.024 | -0.011 |
| EB-6YO | -0.1719 | 0.0496 | -3.5 | 0.001 | -0.045 | -0.111 | 0.0204 | -5.4 | 0.000 | -0.027 |
| Mil/Civ Pay | 0.1242 | 0.0435 | 2.9 | 0.004 | 0.032 | 0.1657 | 0.0512 | 3.2 | 0.001 | 0.041 |
| Unemployment | -0.0125 | 0.0024 | -5.2 | 0.000 | -0.003 | -0.0237 | 0.0028 | -8.6 | 0.000 | -0.006 |
| Population Density | 0.2440 | 0.1000 | 2.4 | 0.015 | 0.064 | 0.5304 | 0.1540 | 3.4 | 0.001 | 0.131 |
| Mean Attrition Rate | 0.18 | | | | | 0.16 | | | | |
| Sample Size | 371,661 | | | | | 250,527 | | | | |
| Log Likelihood | 164835 | | | | | 103857 | | | | |

# CHAPTER 6

# CHOICE OF INCENTIVES AND TERM OF ENLISTMENT

### *Overview*

This chapter examines the recruits' choice between college fund and enlistment bonus offers, and the decision about length of the initial term of service. The effectiveness of these incentives in expanding market supply depends on their respective "real" (that is, inflation-adjusted) dollar values. For example, if the value of EB is sufficiently high, changes in the value of the ACF or NCF may have virtually no impact on high-quality enlistments. Comparisons between the two benefits is complicated by the fact that college fund benefits are received in the future and are used by only about half of all recipients, whereas EB is received upon completion of basic training. In addition, the values that recruits place on these incentives may vary with characteristics such as race, AFQT score, and other demographic characteristics. The effect of enlistment incentives on choice of an incentive and the term of service decision is examined in the next section.

### *Modeling Incentive and Term of Enlistment Choice*

During the time period covered by this study, a recruit could only receive college fund benefits *or* an enlistment bonus, but not both. To estimate the relative attractiveness of each benefit, one is required to use data on recruits who enter military occupations that are eligible for *either* benefit. Let $PVCF_t$ denote the present value of the ACF or NCF available for a term of t years and $EB_t$ be the enlistment bonus available for that term. Next, let $i$ denote the incentive choice and I denote the value of the choice. Then $I = PVCF$ if the recruit selects the college fund, and $I = EB$ if the bonus is chosen instead. Recruits must make the incentive choice $i$ and term of enlistment choice $t$ simultaneously.[56] Let $U_{i,t}$ denote the utility associated with incentive $i$ and term $t$. $U_{i,t}$ depends on the value of the incentive, observable characteristics ($X_k$ ), and random unobservable factors:

$$U_{i,t} = \theta_{i,t} + \beta I_{i,t} + \alpha_{\mathrm{i,t}} \mathrm{X} + \varepsilon_{i,t} \qquad (6.1)$$

With this model, recruits choose the incentive and term combination that maximizes utility. Consider the case in which there are two incentives and two possible terms. Let $i = C$ denote the ACF or NCF and $i =$ E denote the enlistment bonus. Let $t = 1$ be a short term of enlistment and $t = 2$ a long term. With this model, a recruit will choose the college fund and a short term of enlistment if $U_{C,1} > \max(U_{C,2}, U_{E,1}, U_{E,2})$.

Empirical application of this utility maximization framework requires simplifying assumptions. The first one is that the choice of enlistment incentive and enlistment term can be decomposed into two independent choices. This allows the error term in equation (6.1) to be

[56] In theory, the individual must select a combination of skill, term, and incentive. Estimation of a trivariate choice model is not possible because of the large number of military skills. This chapter focuses on the choices of incentive and term of enlistment conditional on skill category. The next chapter studies the effects of incentives on skill choice.

separated into two uncorrelated components; one component associated with incentive choice (v) and a second component associated with term of enlistment. The error in 6.1 is then given by $\varepsilon_{i,t} = v_i + u_t$. where v and u are uncorrelated. The probability that a recruit chooses a short term of enlistment and the college fund (CF) is then given by

$$\begin{aligned}\Pr(CF \mid t=1) &= \Pr[\theta_{C,1} + \beta PVCF_1 + \alpha_{C,1}X + v_1 + u_1 > \theta_{E,1} + \beta EB_1 + \alpha_{E,1}X + v_2 + u_1] \\ &= \Pr[(\theta_{C,1} - \theta_{E,1}) + \beta(PVCF_1 - EB_1) + (\alpha_{C,1} - \alpha_{E,1})X > v_2 - v_1]\end{aligned} \tag{6.2}$$

Similarly, the probability that a long term of enlistment and the college fund are chosen is given by equation 6.3

$$\begin{aligned}\Pr(CF \mid t=2) &= \Pr[\theta_{C,2} + \beta PVCF_2 + \alpha_{C,2}X + v_1 + u_2 > \theta_{E,2} + \beta EB_2 + \alpha_{E,2}X + v_2 + u_2] \\ &= \Pr[(\theta_{C,2} - \theta_{E,2}) + \beta(PVCF_2 - EB_2) + (\alpha_{C,2} - \alpha_{E,2})X > v_2 - v_1]\end{aligned} \tag{6.3}$$

In this framework, the probability of choosing CF rather than EB, conditional on enlistment term length (i.e., given that the enlistment term choice has been made) is the sum of equations (6.2) and (6.3).

Although the model can be estimated separately for each term of enlistment, the analysis is simplified considerably by pooling the observations. Pooling, however, imposes restrictions on the estimated coefficients. The estimated coefficient on the variable ($PVCF_t \mid EB_t$) estimates the common parameter β in equations (6.2) and (6.3). Pooling also imposes the restriction that the coefficient vector $\alpha_{C,1} - \alpha_{E,1}$ on X in equation (6.2) equals the coefficient vector $\alpha_{C,2} - \alpha_{E,2}$ on X in equation (6.3). Differences in the model intercepts ($\theta_{C,1} - \theta_{E,1}$ in equation 6.2 and $\theta_{C,2} - \theta_{E,2}$ in equation 6.3) are permitted by including a dummy variable for term in the pooled model.

Likewise, using (6.1), a recruits' choice of a specific enlistment term, say Term 1, conditional on receiving the college fund incentive is

$$\begin{aligned}\Pr(Term\ 1 \mid i = C) &= \Pr[\theta_{C,1} + \beta PVCF_1 + \alpha_{C,1}X + v_1 + u_1 > \theta_{C,2} + \beta PVCF_2 + \alpha_{C,2}X + v_1 + u_2] \\ &= \Pr[(\theta_{C,1} - \theta_{C,2}) + \beta(PVCF_1 - PVCF_2) + (\alpha_{C,1} - \alpha_{C,2})X > u_2 - u_1]\end{aligned} \tag{6.4}$$

The probability of choosing Term 1 conditional on choosing an EB instead of the college fund is

$$\begin{aligned}\Pr(Term\ 1 \mid i = E) &= \Pr[\theta_{E,1} + \beta EB_1 + \alpha_{E,1}X + v_2 + u_1 > \theta_{E,2} + \beta EB_2 + \alpha_{E,2}X + v_2 + u_2] \\ &= \Pr[(\theta_{E,2} - \theta_{E,2}) + \beta(EB_1 - EB_2) + (\alpha_{E,2} - \alpha_{E,2})X > u_2 - u_1]\end{aligned} \tag{6.5}$$

Equations (6.4) and (6.5) can specified and estimated as Probit models, where term of service depends on $PVCF_1 - PVCF_2$ or $EB_1 - EB_2$ , the vector X of demographic characteristics and other variables, and a dummy variable indicating the selected incentive. This method also requires pooling data for ACF and EB recipients and imposes two restrictions. The first restriction is that the effects of $PVCF_1 - PVCF_2$ in (6.4) and $EB_1 - EB_2$ in equation (6.5). are both equal to β. The second is that the coefficients on X are identical for ACF and EB recipients

(i.e., that $\alpha_{C,1}$-$\alpha_{C,2}$ = $\alpha_{E,1}$-$\alpha_{E,2}$). The intercept for ACF recipients is permitted to differ from the intercept for EB recipients by including a dummy variable for ACF recipient in the pooled model to allow for the likelihood that intercepts in equations (6.4) and (6.5) are not the same.

Two probability equations, based on (6.2)-(6.5), were defined for the analysis of enlistment incentive and term choices respectively. The first equation defines probability of choosing the college fund (ACF, NCF) or an EB, conditional on choice of enlistment term, by including dummy variables for each term length as independent variables in equations (6.2)-(6.3). Similarly, the second equation defines the conditional probability of choice of enlistment term, given the choice of enlistment incentive, by including a dummy variable for receipt of the ACF (or NCF) as an independent variable in (6.4)-(6.5).

Because each of these two equations are conditional on the dependent variable in the other equation, simultaneous equation bias may occur and affect the estimates of both equations. Specifically, the error terms in the two equations ($v_1 - v_2$ and $u_1 - u_2$, respectively) may be correlated. If so, the estimation procedure described here could result in biased and inconsistent estimates of the effects of all of the right-hand side variables. This can be resolved by specifying a bivariate Probit model that allows for the simultaneous determination of the two decisions – choice of incentive and term of enlistment decision.[57] The bivariate Probit model allows for correlation between the error terms in the two conditional probability equations and yields consistent estimates of all parameters. Results of our analysis, reported in the next section, include estimates of the two conditional probability equations for enlistment incentive and term choice, respectively, as well as the bivariate Probit model that estimates these equations simultaneously.

### *Empirical Analysis for the Army*

Probit probability equations of term and incentive choices, respectively, were estimated for the period FY94-98. The database for the analysis consisted of all contract records of Army recruits who enlisted in MOS that were eligible for both the ACF and an EB. There were 63,483 such observations. Of these, 31,497 recruits were enlisted in MOS where the option of both ACF and EB was available for more than one term of enlistment. Consequently, while the Probit estimation of incentive choice used all 63,483 observations, the Probit model of term choice, as well as the bivariate Probit model, was estimated using data only where the ACF/EB option was available for more than one term of enlistment.

## *Enlistment Incentive Choice*

Estimates of the Probit model of incentive choice are contained in Table 6.1 The variable PVCF/EB measures the value of the ACF relative to EBs. The sample mean of this ratio, 2.5, indicates that the present value of ACF benefits were 2.5 times the average bonus. The estimated effect of this ratio is significantly positive, and it demonstrates that recruits are more likely to choose ACF as its dollar value rises relative to the dollar value of EBs. Each unit increase in PVCF/EB (e.g., from 2.5 to 3.5) increases the probability of selecting ACF by 8.4 percent.

[57] See Greene (2000) for a complete discussion of Bivariate Probit models.

Similarly, doubling the size of EB (which reduces PVC/EB to 1.265) reduces the probability of selecting ACF by 0.106 (1.265 times 0.084) or by 22 percent.

**Table 6.1**
***College Fund/Bonus Choice of Army Enlistees Eligible for Both Incentives***

| *Variable* | *Coefficient* | *T-Statistic* | *Significance Level* | *Marginal Effect* | *Variable Mean* |
|---|---|---|---|---|---|
| Intercept | -0.570 | -10.51 | 0.000 | | |
| *PVCF/EB* | 0.215 | 40.50 | 0.000 | 0.084 | 2.533 |
| (*PVCF/EB*) x In School | -0.016 | -1.94 | 0.052 | -0.006 | 0.941 |
| In School | 0.571 | 23.91 | 0.000 | 0.223 | 0.359 |
| AFQT | 0.011 | 26.76 | 0.000 | 0.004 | 69.830 |
| Male | -0.246 | -13.23 | 0.000 | -0.096 | 0.905 |
| Black | -0.110 | -6.25 | 0.000 | -0.043 | 0.111 |
| Hispanic | 0.161 | 6.97 | 0.000 | 0.063 | 0.059 |
| Other | 0.233 | 8.18 | 0.000 | 0.091 | 0.038 |
| Married | -0.662 | -35.51 | 0.000 | -0.258 | 0.115 |
| Unemployment Rate | 0.025 | 5.05 | 0.000 | 0.010 | 5.245 |
| 4+YO | -0.764 | -45.10 | 0.000 | -0.298 | 0.842 |
| FY95 | 0.057 | 2.97 | 0.003 | 0.022 | 0.179 |
| FY96 | -0.129 | -6.32 | 0.000 | -0.050 | 0.144 |
| FY97 | -0.217 | -11.63 | 0.000 | -0.085 | 0.248 |
| FY98 | -0.302 | -15.83 | 0.000 | -0.118 | 0.287 |
| Fraction Choosing CF | 0.483 | | | | |
| Sample Size | 63483 | | | | |
| Log-Likelihood | -37058.1 | | | | |

To test whether recruits who were out of school at the time they enlisted were less motivated by college benefits, a dummy variable was added to the model indicating in-school status and interacted with the PVCF/EB. The estimated marginal effect of 0.223 implies the probability that a recruit still in school will choose the ACF is 22.3 percent higher than if they were out of school. The negative estimate of the in-school interaction with the variable PVCF/EB is also informative. It suggests that the choices of recruits in school are less sensitive to the relative value of the ACF.

Table 6.1 also shows that the probability of choosing the ACF increases by 8 percent for each 10 point in AFQT scores. Other results include the following: females are more likely than males to select the ACF; Hispanics and other Non-black minorities are more likely to choose the ACF than their white counterparts. Blacks are more likely to choose EB. Married recruits are less likely than single recruits to choose ACF. In addition, higher ACF benefits appear to be more attractive to recruits interested in shorter terms of enlistment. For example, recruits who enlisted for four or more years were 30 percent less likely to choose ACF than those who enlisted for three years. This finding implies that enlistment bonuses are more effective than the ACF in channeling recruits into longer terms of service.

In the latter half of FY97 (see Chapter 2), the Army significantly increased the dollar amount of bonuses and expanded MOS coverage. These changes led to a significant increase in the proportion of recruits choosing EB and an equally significant decline in the proportion of recruits choosing the ACF. However, the measure of (relative) dollar value of the ACF, PVCF/EB, in the incentive and term choice Probit models does not account fully for this decline. In particular, the estimates of fiscal year effects display a large negative trend.[58] One explanation is that the model does not predict well when there are large changes in eligibility across MOS. The model estimates are based on the (implicit) assumption that a doubling in expected EB has the same effect, whether it occurs as a result of doubling EB in a given set of MOS, or as a result of doubling the number of MOS that pay a given EB. Further research is necessary to determine whether this is, in fact, the case.

### *Enlistment Term Choice*

Table 6.2 displays Probit equation estimates of the probability that an Army recruit will choose an enlistment term of 4 or more years versus a term of 3 years. These estimates are based on the sub sample of 31,497 records of recruits in MOS that were eligible for the ACF or an EB for two or more terms of service options.

The incentive difference variable (see (6.3)-(6.4)) measures the difference in the value of incentives (in thousands of dollars) between four-year and three-year enlistments. For recruits who selected the ACF, this variable is $PVACF_4 – PVACF_3$. For recruits who chose an enlistment bonus instead, the difference is $EB_4 – EB_3$. Four-year enlistment incentives paid an average of \$3,200 more than three-year incentives. The estimated effect of the value of incentives was large and statistically significant. For example, the estimates indicate that a \$1,000 increase in the value of a four-year compared to a three-year incentive increased the probability of choosing the longer term of service by 7 percent. This is approximately 10 percent when evaluated at the mean proportion of 4YO, 5YO, and 6YO recruits.

Further, the negative interaction term between incentive values and in-school status demonstrates that the effect of changes in financial incentives is smaller for recruits who are in school when they sign an enlistment contract. In addition, recruits who choose the ACF are much more likely to also choose shorter terms of enlistment. This makes economic sense because the value of a college degree increases the longer the period over which an individual can recoup his or her investment. College benefits would therefore appeal to potential recruits interested in shorter terms of military service.

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[58] This trend does not appear to have been captured by the relative value of college benefits (*PVCF/EB*) variable. It may be that small changes in relative value have very small effects when the combined value of enlistment bonus and MGIB college benefits exceeds the value of college fund benefits.

**Table 6.2**
***Term Choice of Enlistees Eligible for Both Incentives at All Terms***

| *Variable* | *Coefficient* | *T-Statistic* | *Signif. Level* | *Marginal Effect* | *Variable Mean* |
|---|---|---|---|---|---|
| Intercept | 0.499 | 6.14 | 0.000 | | 1.000 |
| Difference in Incentive ($1,000) | 0.199 | 25.27 | 0.000 | 0.070 | 3.201 |
| x In School | -0.028 | -2.43 | 0.015 | -0.010 | 1.050 |
| Chose ACF | -1.173 | -66.07 | 0.000 | -0.414 | 0.478 |
| AFQT | 0.000 | -0.58 | 0.564 | 0.000 | 68.787 |
| Black | 0.045 | 1.52 | 0.129 | 0.016 | 0.094 |
| Other | -0.066 | -1.59 | 0.113 | -0.023 | 0.039 |
| Hispanic | -0.131 | -3.84 | 0.000 | -0.046 | 0.061 |
| Male | -0.115 | -2.51 | 0.012 | -0.040 | 0.966 |
| In School | 0.246 | 6.56 | 0.000 | 0.087 | 0.347 |
| Married | 0.278 | 9.01 | 0.000 | 0.098 | 0.105 |
| Unemployment Rate | 0.043 | 5.65 | 0.000 | 0.015 | 5.186 |
| FY95 | 0.029 | 1.03 | 0.305 | 0.010 | 0.210 |
| FY96 | -0.001 | -0.03 | 0.980 | 0.000 | 0.138 |
| FY97 | -0.225 | -7.05 | 0.000 | -0.079 | 0.191 |
| FY98 | -0.182 | -5.70 | 0.000 | -0.064 | 0.349 |
| Fraction 4-YO | 0.691 | | | | |
| Sample Size | 31497 | | | | |
| Log-Likelihood | -15818.59 | | | | |

Table 6.2 also shows that choice of enlistment term differs according to demographics. Hispanics chose shorter terms of service than Whites. Differences between Blacks and Whites were not statistically significant however. Males were 4 percent less likely than females to choose a longer term of Service. Being in school and being married were both associated with longer terms of service.

Higher unemployment rates could lead to shorter enlistment terms because if recruits who enlist as unemployment increases are less propensed toward a military career. On the other hand, when unemployment is high, those who enlist may do so for job security reasons. One would expect terms of enlistment to be increase as the unemployment rate rises. The unemployment effects in Table 6.2 suggest the latter motivation is predominant.

Recall that when the incentive and term choice equations are estimated separately, the estimates in Table 6.2 may include component due to simultaneous equation bias. A bivariate Probit model, however, eliminates this bias by joint estimation of the two conditional probability choice equations. Table 6.3 shows the results of estimating a bivariate Probit model of the joint choice of enlistment incentive and term (excluding 2YO). Because both choices are jointly determined, the incentive choice and term choice dummy variables are no longer included as independent variables. Comparing the estimates in Table 6.3 with the previous results suggest

that the estimated effects of relative incentives are somewhat larger than the estimates in Tables 6.1 and 6.2. However, most of the other estimated effects are very similar to the Probit results.

**Table 6.3**
***Bivariate Probit Model of Incentive and Term Choice***

| *Variable* | *Coefficient* | *T-Statistic* | *Significance Level* | *Marginal Effect* | *Variable Mean* |
|---|---|---|---|---|---|
| | | | ***Incentive Choice*** | | |
| Intercept | 0.553 | -6.64 | 0.000 | | 1.000 |
| PVACF/EB | 0.222 | 30.06 | 0.000 | 0.086 | 2.202 |
| (PVACF/EB) x In School | -0.011 | -0.91 | 0.362 | -0.004 | 0.781 |
| AFQT | 0.010 | 17.70 | 0.000 | 0.004 | 68.787 |
| Black | -0.220 | -8.10 | 0.000 | -0.086 | 0.094 |
| Other | 0.240 | 6.05 | 0.000 | 0.093 | 0.039 |
| Hispanic | 0.116 | 3.56 | 0.000 | 0.045 | 0.061 |
| Male | -0.405 | -9.07 | 0.000 | -0.158 | 0.966 |
| In School | 0.428 | 13.80 | 0.000 | 0.167 | 0.347 |
| Married | -0.676 | -24.48 | 0.000 | -0.264 | 0.105 |
| Unemployment Rate | 0.000 | -0.03 | 0.976 | 0.000 | 5.186 |
| FY95 | 0.034 | 1.18 | 0.237 | 0.013 | 0.210 |
| FY96 | -0.171 | -5.57 | 0.000 | -0.067 | 0.138 |
| FY97 | -0.639 | -21.37 | 0.000 | -0.249 | 0.191 |
| FY98 | -0.712 | -24.86 | 0.000 | -0.278 | 0.349 |
| | | | ***Term Choice*** | | |
| Intercept | -0.223 | -2.92 | 0.004 | | |
| Incent diff | 0.222 | 30.77 | 0.000 | 0.078 | 3.201 |
| Incent diff x Ln Sch | -0.036 | -3.39 | 0.001 | -0.013 | 1.050 |
| AFQT | -0.004 | -7.57 | 0.000 | -0.002 | 68.787 |
| Black | 0.122 | 4.39 | 0.000 | 0.043 | 0.094 |
| Other | -0.158 | -4.03 | 0.000 | -0.055 | 0.039 |
| Hispanic | -0.168 | -5.25 | 0.000 | -0.059 | 0.061 |
| Male | 0.077 | 1.77 | 0.078 | 0.027 | 0.966 |
| In School | 0.096 | 2.74 | 0.006 | 0.034 | 0.347 |
| Married | 0.518 | 18.01 | 0.000 | 0.181 | 0.105 |
| Unemployment Rate | 0.041 | 5.70 | 0.000 | 0.014 | 5.186 |
| FY95 | 0.034 | 1.25 | 0.212 | 0.012 | 0.210 |
| FY96 | 0.061 | 2.06 | 0.039 | 0.021 | 0.138 |
| FY97 | 0.023 | 0.77 | 0.439 | 0.008 | 0.191 |
| FY98 | 0.060 | 1.99 | 0.046 | 0.021 | 0.349 |
| RHO | -0.443 | -39.92 | 0.000 | | |
| Sample Size | 31497 | | | | |
| Log-Likelihood | -35036.6 | | | | |

## *Empirical Analysis for the Navy*

### *Incentive Choice*

Analysis of choice of incentive and term of service for the Navy was hindered by the fact that few Navy ratings were eligible for both the NCF and EB programs. The data revealed that recruits who enlisted in the Navy's Nuclear Field (NF) program have been eligible for both incentives since FY95. Table 6.4 shows the results of estimating a Probit equation of the NCF/EB choice for 7,616 recruits in NF Ratings.

**Table 6.4**
***College Fund/Bonus Choice of Navy Nuclear Program Enlistees***

| *Variable* | *Coefficient* | *T-Statistic* | *Significance Level* | *Marginal Effect* | *Variable Mean* |
|---|---|---|---|---|---|
| Intercept | -2.1584 | -8.99 | 0.0000 | | 1.000 |
| PVNCF/EB | 0.3802 | 18.76 | 0.0000 | 0.148 | 2.794 |
| PVNCF/EB× In School | -0.2566 | -10.59 | 0.0000 | -0.100 | 1.545 |
| In School | 1.1644 | 14.50 | 0.0000 | 0.454 | 0.431 |
| AFQT | 0.0013 | 0.46 | 0.6457 | 0.001 | 89.612 |
| Male | -0.1700 | 3.20 | 0.0014 | -0.066 | 0.094 |
| Black | 0.0419 | 0.69 | 0.4927 | 0.016 | 0.056 |
| Hispanic | -0.0502 | -0.71 | 0.4792 | -0.020 | 0.054 |
| Other | 0.1055 | 1.65 | 0.0995 | 0.041 | 0.057 |
| Married | -0.6493 | -5.40 | 0.0000 | -0.253 | 0.025 |
| Unemployment Rate | 0.0530 | 3.95 | 0.0001 | 0.021 | 5.400 |
| FY96 | 0.5490 | 11.67 | 0.0000 | 0.214 | 0.377 |
| FY97 | 0.4315 | 8.21 | 0.0000 | 0.168 | 0.314 |
| Fraction Choosing CF | 0.418 | | | | |
| Log-Likelihood | -4620.03 | | | | |
| Sample Size | 7616 | | | | |

The estimates are similar to those for the Army. The probability of choosing NCF is positively related to the value of the NCF relative to EB. However, the estimate is considerably larger than the Army estimate. In addition, the probability of selecting the NCF is higher for those in school, females, and unmarried recruits. There are also smaller racial differences for the Navy compared to the Army. Finally, the NCF is more likely to be chosen as the unemployment rate increases. [59]

[59]Like their Army counterparts, NF recruits in school are less sensitive to the relative value of college benefits. However, this finding could be spurious. The Navy attempts to smooth out seasonal variations in entry by offering higher bonuses to enter during less popular winter and spring months. The relative value of the NCF is therefore higher in summer months. Many NF recruits sign contracts near the start of their senior year in high school. Because recruits can not remain in DEP for more than 12 months, they must access during the summer and fall months after high school graduation. This will generate a negative estimate for the interaction between the relative value of the NCF and in-school status. This caveat does not apply to the Army.

### *Enlistment Term Choice*

In equation (6.6), high-quality 5YO and 6YO contracts in state *s* and month *t*, $N^{56}_{s,t}$, are specified as a function of total high-quality contracts, $N_{s,t}$, and the value of incentives offered to 5YO and 6YO recruits relative to those paid to 3 and 4YO recruits. The contracts variable is expressed on a per capita basis using each state's 17-21 year-old population as the base.

$$N^{56}_{s,t} = \beta_1 + \beta_2 N_{s,t} + \beta_3 \left(\frac{PVCOLL56}{PVCOLL34}\right)_t + \beta_4 EEB^{56}_t + u_{s,t} \qquad (6.6)$$

The relative value of college benefits is measured by the ratio of the expected present values of college benefits available to 5YO and 6YO recruits to the present value available for 3YO and 4YO recruits. The variable $EEB^{56}$ is the expected bonus for 5YO and 6YO enlistments, and is defined as the fraction of these recruits eligible for a Navy EB multiplied by the average EB amount.[60] The coefficients $\beta_2$, $\beta_3$, and $\beta_4$ are all expected to be positive.

Table 6.5 reports the estimates of equation (6.6).[61] All coefficients had the expected sign and were statistically significant. If high-quality enlistments increase by 10, 5YO and 6YO enlistments are predicted to rise by 3.7. In other words, holding constant the relative values of incentives, 37 percent of high-quality recruits sign 5 or 6-year contracts.[62] The estimates indicate that relatively higher college benefits and higher enlistment bonuses induce recruits to choose longer terms of service.

Mean values of the independent variables are shown in the right-most column of Table 6.5. As can be seen, the variable $\text{PVCOLL}^{56}$ is only 73.5 percent that of the variable PVCOLL.[34] The reason is straightforward. NCF dollar amounts were the same for 4YO, 5YO, and 6YO enlistments during the study period. However, benefits for 5YO and 6YO contracts are discounted by a greater amount since they are received further in the future. The estimates in Table 6.5 imply that equalizing $\text{PVCOLL}^{56}$ and $\text{PVCOLL}^{34}$ would increase the 5YO and 6YO enlistment shares by 0.07, from 0.35 to 0.46.[63] The average value of the expected EB was $1,883. Doubling the expected EB to $3,766 would increase 5YO and 6YO enlistments as a share of total high-quality enlistments from 0.35 to 0.39.[64]

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[60] Recall that the Navy awarded enlistment bonuses only to enlistees who signed 5 and 6-year contracts during the study period.

[61] Because the variable $N_{s,t,}$ is endogenous, Ordinary Least Squares estimates will be biased and inconsistent. Most importantly, the estimate of $\beta_2$ will be biased upward because random factors that cause $N_{s,t}$ to be unusually high or low will also cause $N^{56}_{s,t}$ to be unusually high or low. Therefore, the equations for total high-quality enlistments were used to calculate predicted values of $N_{s,t}$, which were then used as an instrumental variable in equation (7.6).

[62] This estimate was equal to the average share of 5YO and 6YO contracts. The average value of $N^{56}_{s,t}$ was 0.10 and the average value of $N_{s,t}$ was 0.283. Thus, 5YO and 6YO contracts averaged (.10/.283=) 35 percent of total contracts.

[63]Based on sample means, the predicted value of $N^{56}_{s,t}$ is equal to 0.10+0.069(1-0.735) = 0.118. Dividing by the combined average 5YO and 6YO share, 0.283, yields 0.418, and, hence, the predicted change of 0.07.

[64] Again, using sample means, the dependent variable would be 0.10+0.006x1.883 = 0.111. Dividing by the average share (0.283) yields 0.392, and the predicted change of 0.04.

**Table 6.5**
***5YO and 6YO Navy Contracts***

| *Variable* | *Coefficient* | *Standard Error* | *T-Statistic* | *Variable Mean* |
|---|---|---|---|---|
| Intercept | -0.065 | 0.004 | -6.914 | |
| Expected HQ Contracts[a] | 0.374 | 0.005 | 72.278 | 0.283 |
| $PVCOLL^{56}/PVCOLL^{34}$ | 0.069 | 0.0008 | 5.173 | 0.735 |
| Expected EB (1000s) | 0.006 | 0.000 | 7.471 | 1.883 |
| R-Square | 0.464 | | | |
| Dependent Variable Mean[a] | 0.100 | | | |
| Sample Size | 6098 | | | |

[a]Per 1,000 17-21 year-old population.

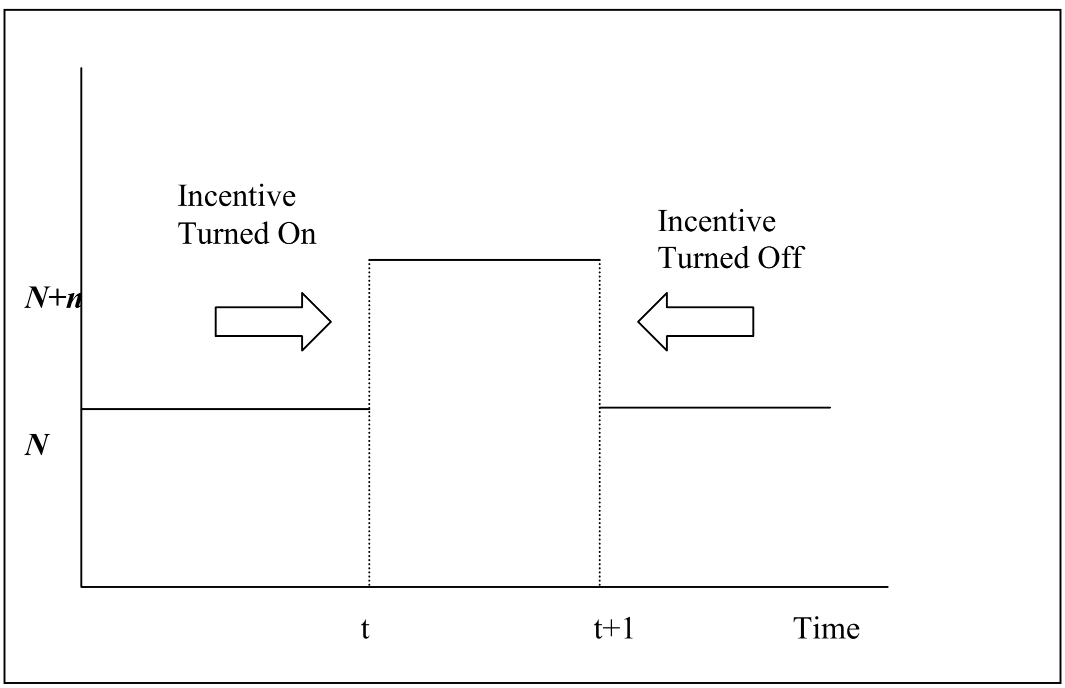
# CHAPTER 7

## SKILL-CHANNELING EFFECTS OF ENLISTMENT INCENTIVES

Research findings discussed in Chapters 4 and 6 demonstrate that enlistment incentives expand the overall supply of high-quality recruits, and also influence incentive choice and initial term of service decisions. This chapter shows that enlistment incentives also channel recruits into hard-to-fill skills. In particular, analysis of Army data shows that changes in eligibility for enlistment bonuses and the Army College Fund have a significant impact on recruits' choices of MOS.

Periodically, the Army re-evaluates its manpower requirements and responds to changing conditions of supply and demand by "turning on" or "turning off" MOS eligibility for the ACF and EB programs, or changing the dollar amount of EBs in selected MOS. An example of change in eligibility is illustrated by Figure 7.1. Suppose N recruits selected MOS 11X at enlistment in time period t-1. If 11X is eligible for either the ACF, EBs, or both in the next time period, t, enlistments in 11X should increase. This is illustrated in Figure 7.1 as an increase of n contracts in 11x to N+n contracts. Further suppose the incentives are removed in the next period, t+1. High-quality enlistments in MOS 11X would then return to their pre-incentive level. Technically, there are 16 possible period-to-period policy combinations similar to the example in Figure 8.1: ACF-on to ACF-off, EB-on to EB-off, ACF-on to EB-on, and so on.

**Figure 7.1**
***Contracts in MOS 11X***



The Army changed enlistment incentive options 39 times between FY87 and FY96. There were 14,658 possible combinations of MOS and YO for each of these 39 program periods. These MOS/YO combinations provide the units of observation for the analysis reported in this chapter. Table 7.1 summarizes eligibility of cells for the ACF and EB programs. About 22 percent of all cells were eligible for the ACF only. They included over 33 percent of all high-quality recruits in the Army. Just over 13 percent of all cells were eligible for EB only. However, these cells included only 4.7 percent of the Army's high-quality recruits.[65] Therefore, the MOS in the EB program during this period were relatively small.

Targeting EBs at smaller MOS makes economic sense. Enlistment bonuses can be thought of as a pay premium offered in a limited number of occupations. Awarding EBs in large MOS would come close to an across-the-board pay increase. The supply analysis in Chapter 4 found that the marginal cost of attracting high-quality recruits through changes in pay was $33,000. On the other hand, the marginal cost estimate of expanding high-quality supply using EBs was only $12,800 (i.e., EBs are cost-effective compared to military pay). There are two reasons for this difference. First, recruiters can narrowly target bonuses to individuals who would not otherwise sign enlistment contracts. Secondly, individuals can be channeled into skills in which men and women are in short supply.

**Table 7.1**
***Incentive Frequencies from Minimaster (FY 1987-96 Data)***

| *Eligible For* | *Number of Cells* | *Number of Contracts* | *ACF Take Rate* | *EB Take Rate* | *Contracts Per Cell* |
|---|---|---|---|---|---|
| Neither | 8297<br>(56.6%) | 212,875<br>(42.3%) | 0 | 0 | 25.65 |
| ACF | 3311<br>(22.6%) | 167,058<br>(33.2%) | 86% | 0 | 50.44 |
| EB | 1948<br>(13.3%) | 23,752<br>(4.7%) | 0 | 94% | 12.98 |
| Both | 1102<br>(7.5%) | 99,749<br>(19.8%) | 41% | 45% | 90.52 |
| Total | 14,658 | 503,434 | 37% | 13.4% | 34.34 |

Of the 16 possible policy combinations noted previously, four involve no change in policy.[66] In addition, Table 7.2 shows that there were 293 cases in which a MOS initially eligible for neither incentive became eligible only for the ACF. Similarly, there were 300 cells initially eligible for just the ACF that were ineligible for either enlistment incentive in the subsequent period. However, there were only 9 cases in which a cell eligible for only the ACF in one period became eligible for only EBs the next period. The ability to estimate the effects of such program changes is limited.

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[65] The data in Table 7.1 indicate that a small percentage of recruits in cells eligible for an incentive do not receive one. The take-rate in ACF-only cells, for example, was 86 percent. In cells eligible for both incentives, 41 percent selected the ACF, 45 percent chose an EB, and 14 percent received neither. Although this could be a result of data error, it seems likely that some of these recruits received other incentives (e.g., loan repayment or guaranteed assignment). These percentages are similar to rates computed using data from the Army's EAF file (see Chapter 6).
[66] The four cells are: Neither to Neither, ACF to ACF, EB to EB, and BOTH to BOTH.

**Table 7.2**
***Army Enlistment Incentive Changes***

| | *To* | *Neither* | *ACF* | *EB* | *BOTH* |
|---|---|---|---|---|---|
| ***From*** | | | | | |
| Neither | | … | 293 | 111 | 56 |
| ACF | | 300 | … | 9 | 97 |
| EB | | 127 | 16 | … | 101 |
| BOTH | | 36 | 125 | 86 | … |

Two models of skill channeling are estimated. In both models, the dependent variable is the percent change in the number of contracts in a given MOS-YO cell between period t-1 and period t.[67] The first model estimates the effects of program changes using dummy variables for each change as explanatory variables. The second model includes the period-to-period changes in the value of enlistment incentives available to each combination of MOS and YO. The change in the enlistment bonus is easily observed. The change in college benefit incentive is measured by the change in the present value of ACF benefits.[68]

Two additional variables are included in the models as control variables. First, the 39 program periods between FY87 and FY96 were not of uniform duration, ranging from a few weeks to over 6 months. The percent change in the number of days between program periods is, therefore, included in order to control for the different lengths of the program periods. Second, the percent change in Army high-quality enlistment contracts between period t-1 and period t is included to control for the effect of overall recruiting. For instance, higher overall recruiting success will be associated with higher recruiting within an MOS/YO cell over and above that attributable to an incentive program.

The estimates are shown in Table 7.3. Cells with fewer than 5 contracts were excluded from the database to eliminate scale effects of small cells. This reduced the number of observations to 10,758. There was also some evidence of heteroscedasticity. This problem was corrected by using a weighted least squares regression model. The weight variable is the number of Army high-quality contracts in each period.

[67] Using the change in percentages rather than in levels corrects for differences in MOS/YOS cell sizes.
[68] For cells eligible for the ACF, present value calculations were based on the appropriate ACF amount; for cells ineligible for ACF, present value calculations were based on the appropriate MGIB amount.

**Table 7.3**
***Model 1: Percent Change in the Number of Contracts in MOS-YO Cells***

| *Variable* | *Coefficient* | *T-Statistic* |
|---|---|---|
| Intercept | 0.245 | 19.28 |
| Percent Change in Number of Days | 0.897 | 52.64 |
| Percent Change in Aggregate High-quality | 0.011 | 2.79 |
| Neither to ACF | 0.508 | 5.84 |
| Neither to EB | 0.420 | 2.55 |
| Neither to Both | 0.709 | 3.82 |
| ACF to Neither | -0.409 | -5.30 |
| EB to Neither | -0.048 | -0.35 |
| Both to Neither | -0.279 | -1.03 |
| EB to ACF | -0.348 | -0.92 |
| ACF to EB | -0.070 | -0.12 |
| ACF to Both | -0.040 | -0.33 |
| EB to Both | 0.346 | 2.29 |
| Both to ACF | -0.291 | -2.82 |
| Both to EB | -0.567 | -3.44 |
| Sample Size | 10758 | |
| $R^2$ | 0.222 | |
| | | |
| **F Tests for Symmetry:** | | |
| Neither to ACF = - ACF to Neither | 0.709 | (accept) |
| Neither to EB = - EB to Neither | 2.984 | (accept) |
| Neither to Both = - Both to Neither | 1.714 | (accept) |
| ACF to Both = - Both to ACF | 4.319 | (reject) |
| EB to Both = - Both to EB | 0.964 | (accept) |

The estimated effects of program policy changes are large and in the expected directions. Most are statistically significant. Each coefficient measures the expected percentage change in contracts in an MOS/YO cell as a result of the indicated program change. For example, the estimate 0.508 in the row labeled "Neither to ACF" indicates that if a cell previously ineligible for either incentive becomes eligible for the ACF, the number of high-quality contracts in the cell increases by 50.8 percent. Making a previously ineligible cell eligible for just an EB increases enlistments by 42 percent. If a cell with no incentive becomes eligible for *both* the ACF and EB, high-quality enlistments increase by a much larger 71 percent.

In theory, effect of switching an incentive off should be of the same magnitude as switching it on, but in the opposite direction. The last rows of Table 7.3 show F-tests for the null hypothesis of symmetry. This symmetry hypothesis could not be rejected in four of the five cases tested.

The second model makes use of the within-cell variations in bonus and college fund amounts by replacing the policy change dummy variables with between-period arithmetic differences in the dollar value of enlistment bonuses and the present value of college benefits. Estimates are shown in Table 7.4. The estimated coefficients on both of these variables are virtually identical (0.069). These estimates imply that a $1,000 increase in the value of a either enlistment incentive results in slightly less than a 7 percent increase in MOS/YO-specific contracts.[69]

**Table 7.4**
***Model 2*: *Percent Change in Number of Contracts in MOS-YO Cells***

| *Variable* | *Coefficient* | *T-Statistic* |
|---|---|---|
| Intercept | 0.244 | 20.18 |
| Pct Change in Number of Days | 0.895 | 52.55 |
| Pct Change in Aggregate High-quality | 0.010 | 2.70 |
| Change in EB ($1,000) | 0.069 | 5.49 |
| Change in PVCB ($1,000) | 0.069 | 7.90 |
| Sample Size | 10758 | |
| $R^2$ | 0.220 | |

In conclusion, these results demonstrate that enlistment bonuses and college benefits are useful not only in expanding the overall supply of high-quality recruits to the military (Chapter 4), but in channeling recruits into longer terms of enlistment (Chapter 6) and into hard-to-fill military occupations as well.

[69] By construction, a reduction of $1,000 would have the same effect in the opposite direction.

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# Appendix A

## Advertising Awareness in YATS

YATS contains a wealth of detailed information regarding youths' awareness of military advertising across a variety of media: TV, radio, magazines, newspapers and billboards. Because the questions regarding advertising changed over the study period, advertising media were divided into two groups: print (magazine, newspaper and billboard advertising) and broadcast (TV and radio). Table A.1 summarizes the major changes in the advertising awareness questions.

**Table A.1**
***Summary of YATS Questions Dealing with Awareness of Military Advertising***

| **Primary Questions** |
|---|
| **1985-1989**<br>Q616: Within the last 12 months , do you recall seeing any advertising for the military in magazines, newspapers, or on billboards?<br>And<br>Q618: Within the last 12 months, do you recall any television or radio advertising for the military? |
| **1990-1991**<br>Q616: Within the past year, do you recall seeing or hearing any advertising for the military? |
| **1992-1998**<br>Q616B: Within the past year, do you recall seeing or hearing any advertising that encourages people to enlist in one or more of the services? |
| **Follow-up Questions** |
| **1985-1989 (Follow Q616 and Q618)**<br>Q617: For which military service did you see this kind of advertising? (Follows Q616)<br>Q619: For which military services did you see or hear this kind of advertising? (Follows Q618) |
| **1990-1991 (Follow Q616 and Q617A)**<br>Q616A: Where did you see or hear any military advertising? Responses are newspaper, magazine, billboard, poster, TV, radio, other.<br>(Follows Q616)<br>Q617: For which military services did you see this kind of advertising? (Follows Q617A) |
| **1992-1998 (Follow Q616B and Q617F)**<br>Q617F: For which military services did you see this kind of advertising? (Follows Q616B)<br>Q616C: Where did you see or hear (insert name of service) advertising? Responses are newspaper, magazines, billboard, poster, TV, radio, letters, pamphlets, videos/movies, internet (added in 1997), other. (Follows Q617F) |

# Appendix B

# Previous Studies of Enlistment Supply

### *Overview of Empirical Findings*

Table B.1 outlines the empirical strategies of fifteen enlistment studies of male high-quality recruits carried out between 1985 and 1996.[70] Eleven of these studies focused on a single Service. In most cases, the purpose of the research was to estimate the effects of changes in a single program or recruiting resource. A number of studies, however, examined econometric issues, including Daula and Smith (1985), Dertouzos (1985), and Berner and Daula (1993).

The factors that determine high-quality enlistment supply fall into three categories: (1) recruiting market factors (relative military pay, unemployment rate, youth population); (2) recruiting resources (number of recruiters, advertising budgets); and (3) recruiting policy variables (recruiting goals, enlistment bonuses, college benefits). Tables B.2-B.4 summarize the findings from the studies in Table B.1 for each of these categories. The studies examine a wide range of time periods, and use different cross-sectional units of observation, theoretical frameworks, and methodologies. Nevertheless, the estimated effects of most variables are reasonably close to one another. In those cases where there are significant discrepancies, it is frequently possible to explain why certain estimates were unusually high or low.

### *Environmental Factors*

***Relative Military Pay***. Table B.2 reports environmental elasticities for the 15 studies in this review. Most studies measured the economic returns to a military career by relative military pay, defined as basic military compensation divided by a measure of the civilian wage. The average elasticity across these studies was 0.942. The estimates ranged from a low of 0.15 (Kearl et al. 1990) to a high of 2.463 (Warner 1990, Navy).[71] The standard deviation of the estimates was large (1.523) as one would expect for such large differences between study findings. The remaining studies, conducted at the Rand Corporation, used the natural log of the civilian wage rather than relative military pay. The mean of the Rand studies was -0.864, with estimates of the civilian pay elasticity ranging from a low of -.28 (Buddin 1991) to a high of -3.1 (Dertouzos 1985, FIML Structural Model for 1980). The wide range of both sets of estimates raises an important question. Which one(s) represent the “best” estimates of the unknown population parameter values? Substantial investigation would be necessary to determine the reasons for the variation in estimates. One source of difficulty is that relative military pay hasn’t

[70] Nelson (1986) summarizes studies performed with data from the 1970s.

[71] Warner’s (1991) pay elasticity for the Navy of 1.9 was also relatively high, but it was comparable to Bohn and Schmitz’s estimate of 1.6 for the Navy, to Daula and Smith’s (1985) supply-constrained estimate of 1.6 for the Army, and to Smith et al.’s (1995) estimate of 1.2 for the Army. Hogan et al. (1996) estimated a median relative pay elasticity of just 0.55 for the Navy.

| Table B.1 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Empirical Strategies*** | | | | | | | | | | | |
| Study | Start Date | End Date | Frequency of Data | Cross-Sectional Unit of Observation | # X-Sec Units | Services Studied | Focus of Study | Theoretical Framework | Estimation Procedure | Fixed Effects? | Log or Linear Model |
| Berner and Daula (1993) | Oct-80 | Jan-90 | Monthly | Battalion | 55 | Army | Econometric: Distinguishes between Supply-Constrained and Near-Supply Constrained Environments | Recruiter Utility Maximization | Estimates 3-regime switching regression model with goals endogenous | Yes | Log |
| Bohn and Schmitz (1996) | Oct-92 | Sep-95 | Monthly | NRD | 31 | Navy | Navy College Fund | Reduced Form | OLS | No | Linear |
| Buddin (1991) | Oct-86 | Sep-90 | Monthly | Battalion | 53 | Army | Army's 2+2+4 Experiment | Recruiter Utility Maximization | Non-linear 3SLS | No | Log |
| Daula and Smith (1985) | Oct-80 | Jun-83 | Monthly | Battalion | 54 | Army | Econometric: Switching regression model to distinguish between supply- and demand-constrained regimes | Supply and Demand | Switching regression model estimated using least squares with Heckman selection correction | Some models | Log |
| Dertouzos (1985) | Dec-79 | Sep-81 | Monthly (10 months/year) | AFEES | 33 | Army | Econometric: First paper to endogenize behavior of the recruiter | Recruiter Utility Maximization | 2SLS and maximum likelihood | No | Log |
| Dertouzos (1989) | Oct-83 | Sep-84 | Monthly | ADI | 210 | All | Advertising Mix Test | Reduced Form | SUR with correction for serial correlation | No | Log |
| Fernandez (1982) | Dec-79 | Sep-81 | Monthly (10 months/year) | AFEES | 66 | Army, Air Force, Navy | Educational Assistance Test Program | Reduced Form | 12-month first difference using LS with correction for heteroskedasticity | Yes | Log |
| Goldberg (1979) | Jul-71 | Dec-77 | Quarterly | Nation | 1 | Navy | Estimation of effects of recruiters and advertising | Reduced Form | Maximum likelihood corrected for heteroskedasticity and autocorrelation | No | Linear |
| Hogan et. al. (1996) | Jan-90 | Dec-94 | Monthly | NRD | 31 | Navy | Advertising | Reduced Form | LS with correction for serial correlation; IV for advertising in some models; allowance for cross-district correlations in some models | Yes | Both |
| Kearl et. al. (1990) | Oct-80 | Dec-89 | Quarterly | Brigade | 5 | Army | General | Reduced Form | GLS (heteroskedasticity) | No | Log |
| Murray and McDonald (1999) | Oct-82 | Sep-93 | Monthly | PUMA | 911 | All | Structural Change in the Recruiting Function | Hybrid Structural and Reduced Form | OLS corrected for heteroskedasticity and serial correlation; IV for some variables | Yes | Log |
| Polich et. al. (1986) | Jul-81 | Jun-84 | Monthly | MEPS | 66 | Army | Enlistment Bonus Experiment | Recruiter Utility Maximization | Two-stage procedure using 3SLS (instrumented LQ recruits) | No | Log |
| Smith et. al. (1990) | Oct-80 | Sep-89 | Monthly | Battalion | 55 | Army | Army College Fund | Enlistee Utility Maximization | OLS -- found that correcting for serial correlation did not affect coefficient estimates | Yes | Log |
| Warner (1990) | Oct-80 | Sep-87 | Quarterly | NRD | 41 | All | General/Cross Service Effects | Reduced Form | OLS | Yes | Log |
| Warner (1991) | Oct-80 | Sep-90 | Annual | NRD | 41 | Navy | General | Recruiter Utility Maximization | OLS and Fixed Effects | Yes | Log |

**Table B.2.**

***Environment Elasticities: Unemployment and Civilian Pay***

| Study | Sample | Youth Pop | Unem. Rate | M/C Pay | Civ. Pay | Measure of Civilian Pay | Population Measure |
|---|---|---|---|---|---|---|---|
| | | Elasticities | | | | | |
| Berner and Daula (1993) | | | 0.485 | 0.480 | | | |
| Bohn and Schmitz (1996) | OLS | | 0.334 | 0.402 | | Unknown | |
| | NRD Dummies Included | | 0.580 | 1.216 | | | |
| | NRD and Month Dummies Included | | 0.193 | 1.644 | | | |
| Buddin (1991) | | | 0.126 | | -0.391 | Mfg (note c) | |
| Daula and Smith (1985) | "Pooled" | 0.142 | 0.562 | 0.494 | | Mfg Prod | QMA |
| | Supply-Constrained | 0.203 | 1.150 | 1.600 | | | |
| | Demand-Constrained | 0.232 | 0.995 | 0.824 | | | |
| Dertouzos (1985) | Red Form, 1980 -- Goals Included | 0.070 | 0.575 | | -0.808 | Mfg. Prod. | 17-21 yr-olds |
| | Red Form, 1981 -- Goals Included | 0.009 | 0.307 | | -0.164 | | |
| | Structural Model 1980 -- 2SLS | 0.091 | 0.764 | | -1.014 | | |
| | Structural Model 1981 -- 2SLS | 0.098 | 0.506 | | -0.700 | | |
| | Structural Model 1980 -- FIML | | 0.658 | | -3.100 | | |
| | Structural Model 1981 -- FIML | | 0.535 | | -2.142 | | |
| Dertouzos (1989) | Army | | 0.649 | | -0.346 | Income per capita | |
| | Navy | | 0.220 | | -0.063 | | |
| | Air Force | | 0.553 | | -0.315 | | |
| | Marines | | 1.629 | | -0.252 | | |
| Fernandez (1982) | Army | | 0.255 | | -0.284 | Hourly earnings | |
| | Navy | | 0.240 | | -1.392 | | |
| | Air Force | | 0.286 | | -1.442 | | |
| Goldberg (1979) | | 5.050 | 0.510 | 0.130 | | (note d) | 18-24 yr-olds |
| Hogan et al. (1996) | | 0.502 | 0.177 | 0.554 | | Unknown | HQ Pop |
| Kearl et al. (1990) | Model 1 (Goals and Propensity in) | (R) 1.0 | 0.570 | 0.150 | | Unknown | 16-21 |
| | Model 2 (Propensity in) | (R) 1.0 | 0.650 | 0.370 | | | |
| | Model 3 (Neither in) | (R) 1.0 | 0.650 | 0.620 | | | |
| Murray and McDonald (1999) | Army Early (1983-87) | 0.080 | 0.110 | 0.190 | | March Current Population Survey (Full-time only) | |
| | Army Late (1990-93) | 0.160 | 0.160 | 0.310 | | | |
| | Marine Corps Early (1983-87) | 0.350 | 0.240 | 0.330 | | | |
| | Marine Corps Late (1990-93) | 0.340 | 0.260 | 0.000 | | | |
| | Air Force Early (1983-87) | 0.160 | | 0.170 | | | |
| | Air Force Late (1990-93) | 0.270 | | 7.460 | | | |
| | Navy Early (1983-87) | 0.330 | | | | | |
| | Navy Late (1990-93) | 0.240 | | | | | |
| Polich et al. (1986) | | (R) 1.0 | 0.942 | | -0.547 | Mfg (note b) | 17-21 |
| Smith et al. (1990) | | (R) 1.0 | 0.600 | 1.200 | | (note a) | |
| Warner (1990) | Army, Trend Included | (R) 1.0 | 0.554 | 0.508 | | Mfg (note b) | 17-21 |
| | Navy, Trend Included | (R) 1.0 | 0.477 | 2.044 | | | |
| | Air Force, Trend Included | (R) 1.0 | 0.203 | -0.346 | | | |
| | Marine Corps, Trend Included | (R) 1.0 | 0.483 | 0.340 | | | |
| Warner (1991): Fixed Effects | | 0.0917 | 0.446 | 1.921 | | Mfg (note b) | HQ Pop |
| | | | | | | | |
| | Mean | 0.523 | 0.504 | 0.942 | -0.864 | | |
| | Standard Deviation | 1.150 | 0.311 | 1.523 | 0.847 | | |
| | Coefficient of Variation | 2.201 | 0.617 | 1.616 | -0.980 | | |

Notes:

Elasticity usually refers to the estimated coefficient in a log-log model.

(R) denotes coefficient restricted to value shown.

a. 5-month centered moving average of log PV(r=0.3) of 4-year Basic Military Comp. / PV earnings of 18-21 civ CPS males

b. Average hourly earnings of production workers in manufacturing, data taken from BLS reports

c. Wages of manufacturing workers, taken from issues of Employment and Earnings

d. Civilian pay was calculated as the 4-yr PV of 18-21 civilian male earnings.
Data were taken from Urban Institute Technical Report 1168.

changed much over time. Limited variation tends to reduce the precision with which the effects of a variable can be estimated. If there are also measurement errors in the data , their effects can dominate time series movements in the variable. The consequence would be to bias the estimated effects of a variable toward zero**.**

A second source of differences is research methodology. For example, some studies include variables to control for permanent differences across geographic areas or across different periods of time. These variables are called "fixed effects." If these fixed effects are correlated with relative military pay or other variables in the model, their omission can yield biased and inconsistent estimates of the variables in the model.[72] Estimation of such models, however, requires data with a relatively long time component. Studies based on a relatively short time-series component may be forced, by necessity, to exclude either geographic or time fixed effects. The consequence could be either over- or underestimation of the true effects of various factors on recruiting.

***Unemployment.*** The mean unemployment elasticity of previous studies was 0.56, with a standard deviation of 0.31 and a coefficient of variation of 0.56. Estimates range from a low of 0.126 (Buddin, 1991) to a high of 1.629 (Dertouzos 1989, Marines). As measured by the coefficient of variation, estimates of the unemployment elasticity vary much less than estimates of the relative pay elasticity. Unlike relative pay, limited variation is less of a problem for unemployment, which may vary between 50 and 100 percent over a typical business cycle. This greater variation enhances the precision with which the effect of unemployment on recruiting may be estimated.

Some studies focused on periods with limited variation in unemployment. For example, the 1986-90-time period studied by Buddin (1991) and the 1983-84 period studied by Dertouzos (1989) were both free of major economic downturns. The relatively limited variation in unemployment for those studies may account for the relatively small unemployment elasticities they estimated. Hogan et al. (1996) estimated an unemployment elasticity for the Navy of only 0.177. Although the time period he analyzed included the recession of 1990-91, this recession was relatively moderate (if prolonged), and his data had relatively less cross-sectional variation (31 Navy Recruiting Districts) than Buddin's (53 Battalions) or Dertouzos [210 Areas of Dominant Influence (ADI)].

### Recruiting Resources

***Recruiters.*** Table B.3 shows estimates of recruiters and advertising elasticities found in previous studies. Excluding Warner's (1990) negative estimate for the Air Force, estimates of the recruiter elasticity range from a low of 0.090 for the Air Force (Fernandez 1982) to 1.65

[72] A biased estimator has an average value in repeated (finite) samples that is not equal to the true parameter. An inconsistent estimator is one that does not approach the true parameter value as the sample size approaches infinity.

**Table B.3**
***Resource Elasticities***

| Study | Sample | Elasticities: Advertising Own-Nat | Own-Loc | Joint-Nat | Oth Serv | Recruiters Own | Oth Serv | Advertising Measure National | Local |
|---|---|---|---|---|---|---|---|---|---|
| Berner and Daula (1993) | | 0.208 | | | | 0.274 | | Imp | |
| Bohn and Schmitz (1996) | | | | | | | | | |
| | OLS | | | | | 0.221 | | | |
| | NRD Dummies Included | | | | | 0.346 | | | |
| | NRD and Month Dummies Included | | | | | 0.139 | | | |
| Buddin (1991) | | | 0.012 | | | 0.238 | 0.140 | | $ |
| Daula and Smith (1985) | | | | | | | | | |
| | "Pooled" | 0.089 | 0.035 | | | 0.585 | | Imp | $ |
| | Supply-Constrained | 0.107 | 0.08 | | | 0.959 | | Imp | $ |
| | Demand-Constrained | 0.156 | 0.051 | | | 0.826 | | Imp | $ |
| Dertouzos (1985) | | | | | | | | | |
| | Reduced Form, 1980 -- Goals Included | | | | | 0.842 | | | |
| | Reduced Form, 1981 -- Goals Included | | | | | 0.466 | | | |
| | Structural Model 1980 -- 2SLS | | | | | 1.193 | | | |
| | Structural Model 1981 -- 2SLS | | | | | 1.086 | | | |
| | Structural Model 1980 -- FIML | | | | | 1.647 | | | |
| | Structural Model 1981 -- FIML | | | | | 1.529 | | | |
| Dertouzos (1989) | | | | | | | | | |
| | Army | 0.028 | | 0.016 | 0.028 | 0.227 | | $ | |
| | Navy | -0.005 | | 0.028 | 0.032 | 0.526 | | $ | |
| | Air Force | 0.071 | | 0.008 | 0.009 | 0.303 | | $ | |
| | Marines | -0.001 | | 0.023 | 0.024 | 0.470 | | $ | |
| Fernandez (1982) | | | | | | | | | |
| | Army | | | | | 0.295 | | | |
| | Navy | | | | | 0.274 | | | |
| | Air Force | | | | | 0.090 | | | |
| Goldberg (1979) | | 0.140 | | | | 1.270 | | $ | |
| Hogan et al. (1996): Median Estimates | | | | | | 0.286 | | | |
| | TV | 0.028 | | 0.031 | | | | Imp | |
| | Radio | 0.021 | | 0.009 | | | | Imp | |
| | Mailings | 0.038 | | 0.029 | | | | Imp | |
| Kearl et al. (1990) | | | | | | | | | |
| | Model 1 | 0.430 | | | | 0.480 | | $ | |
| | Model 2 | 0.580 | | | | 0.680 | | $ | |
| | Model 3 | 0.720 | | | | 1.150 | | $ | |
| Murray and McDonald (1999) | | | | | | | | | |
| | Army Early (1983-87) | | | | | 0.51 | | | |
| | Army Late (1990-93) | | | | | 0.6 | | | |
| | Marine Corps Early (1983-87) | | | | | 0.53 | | | |
| | Marine Corps Late (1990-93) | | | | | 0.62 | | | |
| | Air Force Early (1983-87) | | | | | 0.49 | | | |
| | Air Force Late (1990-93) | | | | | 0.59 | | | |
| | Navy Early (1983-87) | | | | | 0.33 | | | |
| | Navy Late (1990-93) | | | | | 0.24 | | | |
| Polich et al. (1986) | | 0.056 | 0.013 | | | 0.597 | | $ | |
| Smith et al. (1990) | | 0.050 | | | | 0.150 | | $ | |
| Warner (1990) | | | | | | | | | |
| | Army, Time Trend Included | 0.103 | | 0 | -0.007 | 0.371 | 0.254 | $ | |
| | Navy, Time Trend Included | 0.015 | | -0.004 | -0.396 | 0.412 | 0.196 | $ | |
| | Air Force, Time Trend Included | -0.034 | | 0.004 | -0.149 | -0.045 | 0.062 | $ | |
| | Marine Corps, Time Trend Included | -0.017 | | 0.001 | -0.081 | 0.487 | -0.067 | $ | |
| Warner (1991): Fixed Effects | | 0.050 | | -0.028 | | 0.527 | | $ | |
| | | | | | | | | | |
| | Standard Deviation | 0.196 | 0.028 | 0.017 | 0.147 | 0.385 | 0.125 | | |
| | Mean | 0.129 | 0.038 | 0.010 | -0.068 | 0.556 | 0.117 | | |
| | Coefficient of Variation | 1.526 | 0.745 | 1.747 | -2.181 | 0.691 | 1.068 | | |

Notes:
$=Expenditures; Imp=Impressions
Daula and Smith (1985): National advertising impressions, local advertising expenditures
Warner (1991): Advertising deflated
Dertouzos (1989): Other service advertising is Army advertising
Bohn and Schmitz (1996): Linear model; elasticities evaluated at the means

(Dertouzos 1985, FIML model for 1980). Because recruiters are endogenous, estimates based on fixed effects are probably less biased than are other estimates.[73]

***Advertising.*** The mean national advertising elasticity was 0.14. The standard deviation of the elasticities was around 0.2, indicating the existence of substantial differences in estimates across studies. At one extreme, Kearl et al.'s research yielded an estimated elasticity of 0.7, three times larger than the next highest estimate in the literature of 0.2 (Berner and Daula, 1993). In addition, this estimate is more than 30 times higher than estimates by Dertouzos' (1989) for Army advertising and Hogan et al. (1996) for Navy TV advertising. At the other extreme, a number of researchers estimated negative advertising elasticities, including Dertouzos (1985) for the Navy and Marine Corps, and Warner (1990).

Accurate estimation requires meaningful variation in advertising either across geographic markets, over time, or both. Nationwide advertising data are therefore problematic, particularly if advertising varies only slightly about a trend. For example, Warner (1990) estimated a Navy advertising elasticity of 0.015 without a time trend included, and of –0.001 with the trend included. Omitting the time trend runs the risk of omitted variable bias, whereas including it made estimation of the effects of advertising problematic.

The most comprehensive study of advertising to date is Hogan et al. (1996), which examined the impact of Navy advertising. Using a fixed effects model, they estimated a Navy TV elasticity of 0.03, virtually identical to the estimate obtained by Dertouzos (1985) for Army TV advertising. Other elasticity estimated included Navy radio advertising (.02) and magazine advertising (0.04). Elasticities were also estimated for Joint-Service TV (0.031) and radio advertising, and mail advertising (own-Service, 0.038; Joint-Service mail, 0.029).

### *Recruiting Policy Variables*

***Recruiting Goals.*** Table B.4 contains estimates of recruiting policy elasticities. Estimates of the high-quality goal elasticity range from a low of 0.102 (Buddin 1991) to a high of 0.520 (Berner and Daula 1993). Because goals may be endogenous, estimation of their effects may not be straightforward. Goals could be endogenous, for example, if overly optimistic goals are set initially but subsequently have to be lowered. In such a case, random shocks in the dependent variable (enlistment) lead to changes in a right-hand side variable (goals), generating what is known as simultaneous equations bias. In the present case, the bias can manifest itself in the form of a spurious negative relationship between recruiting and goals, biasing the estimated effect of goals downward. The findings of Berner and Daula (1993) are consistent with this conclusion; they corrected for simultaneity between enlistment and goals, and obtained the highest estimated elasticity among the studies reviewed.

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[73] Estimation procedure may account for the different recruiter elasticities estimated by Fernandez (1982) and Dertouzos (1985). Fernandez (1982) used a fixed-effects estimator in his data set of 67 Military Entrance Processing Stations (MEPS); Dertouzos (1985), who used a 33-MEPS subset of Fernandez's (1982) data set, did not.

**Table B.4.**

***Policy Elasticities: Goals, Bonuses, and Educational Benefits***

| Study | Own-Service Goals HQ | Own-Service Goals LQ Goal | Other-Svc Goals | Educ Benefits | Enlistment Bonus | Remarks |
|---|---|---|---|---|---|---|
| Berner and Daula (1993) | 0.520 | | | -0.041 | 0.460 | d |
| Bohn and Schmitz (1996) | | | | | | g |
| OLS | | | | 0.015 | | h |
| NRD Dummies Included | | | | 0.033 | | h |
| NRD and Month Dummies Included | | | | 0.084 | | h |
| Buddin (1991) | 0.102 | -0.041 | | | | f |
| B-Cell (2+2+4 available to all ) | | | | 0.025 | | i |
| C-Cell (2+2+4 available randomly) | | | | 0.031 | | i |
| Daula and Smith (1985) | | | | | | |
| "Pooled" | 0.406 | 0.113 | | 0.083 | | a |
| 8K Option | | | | | -0.002 | i |
| 4K/8K Option | | | | | 0.049 | i |
| Supply-Constrained | 0.150 | 0.332 | | 0.242 | | |
| 8K Option | | | | | -0.185 | i |
| 4K/8K Option | | | | | 0.081 | i |
| Demand-Constrained | 0.186 | 0.169 | | 0.046 | | |
| 8K Option | | | | | -0.042 | i |
| 4K/8K Option | | | | | 0.087 | i |
| Dertouzos (1985) | | | | | | |
| Reduced Form, 1980 | 0.420 | -0.421 | | | | |
| Reduced Form, 1981 | 0.459 | -0.051 | | | | |
| Dertouzos (1989) | | | | | | |
| Army | 0.281 | | | | | |
| Navy | 0.119 | | | | | |
| Air Force | 0.465 | | | | | |
| Marines | 0.215 | | | | | |
| Fernandez (1982) | | | | | | |
| Army | | | | | | |
| Ultra-VEAP kicker | | | | 0.087 | | i |
| Non-contributory VEAP | | | | 0.013 | | i |
| Tuition/Stipend | | | | -0.059 | | i |
| Navy | | | | | | |
| Ultra-VEAP kicker | | | | 0.093 | | i |
| Non-contributory VEAP | | | | 0.038 | | i |
| Tuition/Stipend | | | | 0.100 | | i |
| Goldberg (1979) | | | | | | |
| Hogan et al. (1996) | | | | | | |
| Kearl et al. (1990) | | | | | | |
| Model 1 | 0.33* | | | .01/.13 | | b |
| Model 2 | | | | .04/.15 | | b |
| Model 3 | | | | .04/.12 | | b |
| Murray and McDonald (1999) | | | | | | |
| Army Early (1983-87) | 0.16 | | | 0.07 | | |
| Army Late (1990-93) | 0.08 | | | 0.01 | | |
| Marine Corps Early (1983-87) | | | | | | |
| Marine Corps Late (1990-93) | | | | | | |
| Air Force Early (1983-87) | 0.05 | | | | | |
| Air Force Late (1990-93) | -0.15 | | | | | |
| Navy Early (1983-87) | -0.05 | | | | | |
| Navy Late (1990-93) | -0.06 | | | | | |
| Polich et al. (1986) | 0.216 | -0.039 | | | | e |
| B-Cell ($8,000) | | | | | 0.040 | i |
| C-Cell ($8,000/$4,000) | | | | | 0.049 | i |
| Smith et al. (1990) | 0.270 | -0.090 | | 0.114 | 0.048 | c |
| Warner (1990) | | | | | | |
| Army, Trend Included | 0.215 | 0.010 | -0.105 | 0.368 | | |
| Navy, Trend Included | 0.257 | -0.103 | 0.079 | 0.133 | | |
| Air Force, Trend Included | *NA* | *NA* | 0.526 | -0.064 | | |
| Marine Corps, Trend Included | *NA* | *NA* | 0.080 | 0.035 | | |
| Warner (1991): Fixed Effects | 0.176 | | | 0.147 | | |
| | | | | | | |
| Standard Deviation | 0.177 | 0.198 | 0.268 | 0.095 | 0.162 | |
| Mean | 0.204 | -0.012 | 0.145 | 0.070 | 0.059 | |

*Total Goal

a. Educational Benefit variable is an Army College Fund eligibility dummy variable

b. Coefficient on real discounted PV of ACF benefits/Coefficient on dummy variable for MGIB

c. Bonus effect (from their p. A-22) not an elasticity. ACF elasticity taken from their Model 1, Table A-3, p. A-20

d. Elasticities taken from their Table 6, p. 333

e. Goal Elasticities are reduced form calculated using equation (4) (p. 34)

f. Goal Elasticities are reduced form calculated using equation (3) (p. 26) and assuming H/L = 2.0

g. Educational Benefits: NCF Seats

h. Linear Models; elasticities evaluated at means

i. Coefficients on cell dummy variables

***Low-Quality Goal.*** Dertouzos's (1985) theoretical model suggests that the elasticity of high-quality recruiting with respect to the low-quality goal should be negative. The intuition is that recruiting low-quality recruits involves shifting effort away from high-quality recruiting. Although a number of studies found evidence of such a tradeoff, the evidence is mixed. For example, Daula and Smith (1985) and Warner (1990) estimated a positive relationship between low-quality goal and high-quality recruiting for the Army.

***Enlistment Bonuses.*** The earliest estimates of the effects of enlistment bonuses were derived from the Army's Enlistment Bonus Experiment (EBE). Polich et al. (1986) analyzed data from this experiment, which offered two programs and lasted from July 1982 until June 1984. The first program raised the maximum signing bonus for a four-year enlistment from $5,000 to $8,000. The second program introduced a $4,000 bonus for a three-year enlistment. Seventy percent of the geographic area covered by the U.S. Army Recruiting Command was assigned to a control cell (cell A), where the maximum signing bonus was $5,000. Another fifteen percent was assigned to the 8K option (cell B). The remaining fifteen percent was allocated to the 4K/8K cell (cell C) for 3- and 4-year terms of enlistment.[74]

Polich et al. (1986) used monthly data that covered the test period along with a one-year base period. They estimated a market expansion effect of the program in effect in cell B of 4 percent, and in cell C of 5 percent, relative to the one in effect in cell A (their table 10, p. 37). About 21 percent of all high-quality recruits entered test-eligible skills for four-year terms (footnote 10, p. 40). A $3,000 increase in the maximum bonus amounted to about a 7 percent increase in four-year compensation. Their estimates imply that a (.21 times .07) 1.5 percent increase in expected four-year compensation led to a 4 percent expansion in high-quality contracts, an elasticity of 2.7.[75] Because the estimated elasticity is larger than the pay elasticities typically estimated, it is probably too high.

Daula and Smith's (1985) study also included data from the EBE period. In contrast to Polich et al. (1986), they did not find statistically significant market expansion effects of the program in cell B. They did, however, estimate a market expansion effect of 21 percent in cell C in their fixed-effects models using only supply-constrained observations – a much larger effect than estimated by Polich et al. (1986). This estimate, which implies an elasticity of high-quality enlistment with respect to pay of around 9, is also too high.[76]

***College Benefits.*** Fernandez (1982) studied the Educational Assistance Test Program (EATP).[77] In this program, each of the 67 Armed Forces Entrance and Examining Stations was

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[74]Daula and Smith (p. 288) noted that the control cell had bonuses that ranged from $1,500 to $5,000, and the B-cell had bonuses ranging from $2,500 to $8,000.

[75] They cautioned that because test-eligible and non-eligible skills are not necessarily "perfect substitutes in the eyes of prospects," one cannot precisely predict the effect of expanding eligibility to other skills.

[76] The estimated market expansion effect of the 4K/8K bonus was about 21 percent. They noted (footnote 26) that a $4,000 bonus corresponded roughly to an 11 percent increase in first-term pay. They concluded that the implied pay elasticity was therefore equal to (21/11 = ) 2.0. However, only 21 percent of high-quality recruits were eligible for the bonus. If $4,000 was equivalent to an 11 percent increase in first term pay, first term pay must have been about $36,364 (solve 1.11x = x+4,000 for x). The *expected* increase in first-term pay was therefore about 0.21 times $4,000 divided by $36,364, or 2.3 percent. The implied pay elasticity is therefore (21/2.3)=9.1.

Veteran's Educational Assistance Program (VEAP), with Army kickers up to $6,000. The Ultra-VEAP kicker cell (19 percent) featured Army kickers of up to $12,000; other Services offered the basic VEAP only. The noncontributory VEAP cell (15 percent) featured a program developed by the Senate in which DoD paid the individual's VEAP contribution, and featured Army kickers of up to $6,000. The Tuition/Stipend cell (15 percent) featured a program developed by the House of Representatives that offered tuition assistance of up to $1,200 per year plus a $300 per month subsistence allowance, indexed for inflation. The benefits were transferable to dependents, and participants had the option of cashing out the benefits upon re-enlistment.

Fernandez (1982) compared high-quality enlistment in each test program cell with enlistment in the control cell between a base period (December 1979-September 1980) and the test period (December 1980-September 1981).[78] The estimated program effects for the Army were 8.7 percent for the Ultra-VEAP cell, 1.3 percent for the noncontributory VEAP cell, and -5.9 percent for the Tuition/Stipend cell. The corresponding effects for the Navy were 9.3 percent, 0.8 percent, and 10.0 percent.[79] Apparently, the Tuition/Stipend program, by eliminating the Army's kicker advantage, had a positive effect on Navy enlistment at the expense of the Army.

A second educational benefits test known as the 2+2+4 Recruiting Experiment was analyzed by Buddin (1991). In this test, recruits were offered Army College Fund (ACF) benefits of $8,000 in a participating non-combat skill if they committed to three conditions. The three conditions were (1) two years of service plus training time, (2) two years in the Selected Reserve, and (3) four additional years (for a total of eight years) in the Individual Ready Reserve. The nation was again divided geographically into three test cells. The program was not available in cell A (20 percent of the nation), available to all recruits in cell B (20 percent), and available to 70 percent of recruits in cell C (60 percent). About 5,700 recruits enlisted in the program. Buddin (1991) estimated a 3 percent market expansion effect of the 2+2+4 program. Although this is markedly smaller than the 8.7 percent effect estimated by Fernandez, Buddin (1991) noted that the 2+2+4 framework was a marginal extension of an existing ACF program. Moreover, the 2+2+4 program was available only to 20 percent of high-quality recruits.

Smith et al. (1990) estimated the impact of Army College Fund benefits on high-quality enlistment by constructing a variable that measured the expected present value of college benefits. This variable was entered into the high-quality enlistment supply equation. They estimated the market expansion effect of the Army College Fund to be about 5 percent. Bohn and Schmitz (1996) estimated the effects of the Navy College Fund by entering the number of NCF positions filled as an explanatory variable in the high-quality enlistment supply equation. Using a fixed-effects model, they estimated that each 10 percent increase in Navy College Fund positions offered increased high-quality enlistment supply by about 8.4 percent.

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[77] What follows is taken from p. 13 of Fernandez (1982).
[78] The analysis was not conducted for the Marine Corps, whose implementation of the test differed markedly from that of the other services.
[79] The corresponding effects for the Air Force (not shown in the table) were 2.7 percent, 5.5 percent, and 7.8 percent.

### *Cross-Service Effects and Skill Channeling*

An important concern of policy makers is the possibility that expanding resources in one Service merely reallocates recruits away from other Services. For example, Buddin (1991) found evidence of such an effect in his analysis of the 2+2+4 Recruiting Experiment (discussed above). In practice, cross-Service effects have been difficult to identify. For example, Warner (1990) included other Services' total goal models of high-quality enlistment supply. Although Warner (1990) estimated other-Service goals to have a negative effect on high-quality enlistment in the Army, he found a positive cross-Service effect for the Navy, Air Force, and Marine Corps.

Finally, educational benefit and enlistment bonus programs are normally targeted to hard-to-fill skills. A number of researchers have examined whether these programs are, in fact, successful in channeling recruits into hard-to-fill skills or in choosing longer terms of enlistment. Fernandez (1982) found evidence of skill-channeling in his analysis of the EATP program for the Army and Air Force. Polich et al. (1986) found strong skill- and term-of-service channeling effects using data from the Army's Enlistment Bonus Experiment. Finally, Buddin (1991) found evidence of both skill- and term-of-service channeling in his analysis of the Army's 2+2+4 educational benefit program.

## *Empirical Methodologies of Previous Enlistment Supply Studies*

This section summarizes the details of the theoretical and econometric models used in previous enlistment supply research. Some researchers developed highly structured models in which there is a very tight relationship between economic theory and the estimated parameters. To the extent that the theory is correct, the structural approach is preferable. If, however, the theory makes invalid assumptions, the resulting estimates may be no more accurate than those obtained using a reduced-form approach.

### *Dertouzos (1985)*

Dertouzos (1985) introduced the current generation of recruiting supply models. These models are distinguished by accounting formally for the role of recruiters' preferences, the recruiting technology, and recruiter incentives. Let X denote exogenous economic and other environmental variables and let R denote resources devoted to recruiting. Earlier studies assumed implicitly that the supply of low-quality recruits was essentially unlimited, so that the supply of high-quality recruits could be represented as

$$H = f(X,R).$$

Dertouzos (1985) argued that because it takes time and effort on the part of the recruiter to attract and process even "walk-in" recruits, a more appropriate formulation of the supply of high-quality recruits is:

$$f(H,L,X,R) = 0 \tag{B.1}$$

Previous models implicitly assumed that the recruiter's tradeoff between high and low-quality recruits, dH/dL was zero. Equation (B.1) allows for the possibility that dH/dL is nonzero.

Dertouzos (1985) also modeled the incentives of the recruiter, assuming that recruiter utility could be represented as:

$$U = g(H,L,Q), \qquad \text{(B.2)}$$

where Q is a vector containing $Q_H$ and $Q_L$, the enlistment quota for high and low quality recruits, respectively. Recruiters maximize utility subject to the feasibility constraint implied by (B.1), yielding first-order conditions:

$$g_H / g_L = f_H / f_L \qquad \text{(B.3)}$$

Combining equation (B.3) with equation (B.1), reduced-form equations describing the equilibrium rate of high- and low-quality enlistment are:

$$H = \phi_1(X,R,Q) \qquad \text{(B.4)}$$

$$L = \phi_2(X,R,Q) \qquad \text{(B.5)}$$

To estimate this system of equations, Dertouzos assumed that the supply equation (B.1) takes the form:

$$\log(H) = \lambda \log(L) + \beta_X X + \beta_R R + \beta_M M, \qquad \text{(B.6)}$$

where M is a vector of monthly dummy variables to allow for seasonality. Equations (B.4) and (B.5) were also assumed to take log-log forms:

$$\log(H) = \alpha_X X + \alpha_R R + \alpha_Q Q \qquad \text{(B.7)}$$

$$\log(L) = \alpha_X X + \alpha_R R + \alpha_Q Q \qquad \text{(B.8)}$$

Consistent estimates of $\beta_X$ and $\beta_R$ can be obtained by estimating equation (B.6) jointly with equation (B.7) or equation (B.8) using the Two-Stage Least Squares procedure. However, Dertouzos (1985) estimated equations (B.7) and (B.8) simultaneously along with the parameters of the recruiter's utility function in equation (B.3). He assumed that recruiter utility took the following functional relationship:

$$U = \theta \log[(H/Q_H) - \gamma_H] + (1-\theta)[\log(T/Q_T) - \gamma_T] \qquad \text{(B.9)}$$

Maximizing equation (B.9) subject to the supply relationship given by equation (B.6) yields the first-order condition

$$\frac{\theta(T - \gamma_T Q_T)}{(1-\theta)(H - \gamma_H Q_H)} + 1 = L/\lambda H \qquad \text{(B.10)}$$

Dertouzos (1985) estimated equations (B.6) and (B.10) jointly using the method of maximum likelihood. This procedure yielded estimates of the parameters of the recruiter's objective function as well as the underlying parameters of the supply relationships.[80]

### *Polich, Dertouzos, and Press (1986)*

Polich, Dertouzos, and Press (1986) extended the approach of Dertouzos (1985) to evaluate the effects of the Enlistment Bonus Experiment (described above). Whereas Dertouzos (1985) assumed that the utility of the recruiter was independent of effort, Polich, Dertouzos, and Press (1986) allowed effort to enter the recruiter utility function:

$$U = g(E,H,L,Q), \tag{B.11}$$

where E is the level of effort exerted by the recruiter. The equation for enlistment supply was augmented as well:

$$\log(H) = \lambda\log(L) + \beta_X X + \beta_R R + \beta_M M + \log(E), \tag{B.12}$$

where R now includes bonuses. Because E is unobservable, they assumed that

$$\log(E) = \gamma_H(H/Q_H) + \gamma_L(L/Q_L). \tag{B.13}$$

Substitution of equation (B.13) into equation (B.12) yields

$$\log(H) = \eta_L \log L + \eta_X \log X + \eta_R \log R + \eta_M M + \eta_{QH} \log Q_H + \eta_{QL} \log Q_L \tag{B.14}$$

Equation (B.14) can be estimated using the Two-Stage Least Squares procedure by assuming the supply of low-quality recruits follows equation (B.8) above. It is reproduced here for convenience:

$$\log(L) = \alpha_X X + \alpha_R R + \alpha_Q Q, \tag{B.15}$$

where Q contains $Q_H$ and $Q_L$. The structure of the model can be recovered by recognizing that

$$\eta_{QH} = - \gamma_H / (1 - \gamma_H) \tag{B.16a}$$
$$\eta_{QL} = - \gamma_L / (1 - \gamma_H) \tag{B.16b}$$
$$\eta_i = \beta_i / (1 - \gamma_H),\ i = X, R, M \tag{B.16c}$$
$$\eta_L = (\lambda + \gamma_L) / (1 - \gamma_H). \tag{B.16d}$$

Equations (B.14) and (B.15) were estimated jointly, in log-difference form using the Three-Stage Least Squares procedure. The coefficients in equation (B.12) are the market expansion effects reported in their Table 10 (p. 37).

[80] In practice, Dertouzos (1985) noted that the estimation using Two-Stage Least Squares was much simpler and yielded estimated coefficients "invariably similar" to their maximum likelihood counterparts (p. 14, footnote 3).

***Skill- and Term-of Enlistment Channeling.*** To analyze the effects of the Enlistment Bonus Experiment on skill choice, Polich, Dertouzos, and Press (1986) added an equation for enlistment in test-eligible skills, given by:

$$\log(H_E) = \omega_H H + \omega_M M + \omega_B B \qquad (B.17)$$

where $H_E$ denotes the number of high-quality contracts in test-eligible skills and B is a vector denoting test cell. To examine the effects of the Experiment on terms of enlistment choice, they added equations for four-year and three-year enlistment within skills:

$$\log(H_{Ei}) = \omega_{HE} H_E + \omega_M M + \omega_B B \qquad (B.18)$$

where $H_{Ei}$ denotes the number of high-quality i-year (i=3,4) contracts in test-eligible skills.

### Berner and Daula (1993)

Berner and Daula (1993) extended the model of Polich et al. (1986) to account for (1) non-linearity in the effect of recruiter effort on high-quality enlistment and (2) the endogeneity of enlistment quotas. Like Polich et al., they assumed that recruiter was given by:

$$U = E^{\delta_E} + (H/Q_H)^{\delta_H} + (L/Q_L)^{\delta_L} \qquad (B.19)$$

They added error terms to equations (B14) and (B.15) to obtain two other equations to be estimated:

$$Log(H) = \eta_L \log L + \eta_X \log X + \eta_R \log R + \eta_M \log M + \eta_{QH} \log Q_H + \eta_{QL} \log Q_L + \varepsilon_H \qquad (B.20)$$

$$Log(L) = \alpha_X X + \alpha_R R + \alpha_Q Q + \varepsilon_L. \qquad (B.21)$$

***Endogeneity of Quotas.*** Berner and Daula (1993) noted that the U.S. Army Recruiting Command (USAREC) assigned goals for high- and low-quality enlistment to each recruiting battalion each month. These goals were assigned through a four-step process that incorporated DoD demands by quarter and market forecasts of each battalion's potential for supplying high-quality contracts. Thus, goals were a function of predetermined variables used in these forecasts, educational and bonus benefits, and the quarterly national mission. Assuming that there was a three-month lag between the realization of the predetermined variables and the setting of the mission, Berner and Daula assumed:

$$\log(Q_H) = \zeta Z_{-3} + \varepsilon_{QH} \qquad (B.22)$$

Unless the correlation of $\varepsilon_{QH}$ with $\varepsilon_L$ and $\varepsilon_H$ is zero, estimates of equation (B.20) that do not account for the endogeneity of quotas will be biased and inconsistent.

***Non-linearity of Recruiter Effort***. Berner and Daula (1993) argued that because the penalty for underproduction was relatively more severe than the rewards for over-production (p. 320), recruiter effort (see equation 13) would vary according to three regimes

Regime 1: The achievement of the battalion is more than 2 below quota

Regime 2: The battalion is within [-2,2] recruits of the goal

Regime 3: The battalion is more than 2 recruits above goal.

They argued that pressure to produce would be effective in Regime (2), but not in Regimes (1) or (3) (p. 321). Thus, the parameters of the recruiter's utility function (equation B.19) were allowed to vary across these three regimes.

The likelihood equation for the final system involved 10 equations: 3 regimes each for high-quality enlistment, low-quality enlistment, and high-quality goals, and an ordered probit selection equation. Although the system could in principle be estimated by maximum likelihood, its size and complexity rendered this infeasible. Instead, they estimated the system by taking one step from consistent starting values for the parameters. Except for the selection equation, all variables were entered as deviations of battalion means to allow for fixed effects.

### *Smith, Hogan, Chin, Goldberg, and Goldberg (1990)*

Smith et al. (1990) modeled enlistment choice at the level of the individual potential recruit. Let $U_A(A,J_A)$ denote the expected utility of a sequence of jobs that includes Army enlistment, A, today and post-service employment $J_A$ in the future. Similarly, denote the expected utility of a sequence of jobs in which the civilian alternative, C, is pursued today as $U_C(C,J_C)$. The individual will enlist if

$$U_A(A,J_A) > U_C(C,J_C). \qquad \text{(B.23)}$$

The probability that an individual enlists, Π, is a function of the attractiveness of military and civilian job alternatives. Let X denote the value of civilian alternatives, P the eligible population pool, $R_P$ pecuniary recruiting resources (pay, educational benefits, bonuses), $R_I$ information resources, and Q goals. Smith et al. (1990) specified Π as:

$$\log\Pi = \kappa_X X + \kappa_{RP} R_P + \kappa_{RI} R_I + \kappa_M M + T + u, \qquad \text{(B.24)}$$

where T is the individual's taste for military life, M is a vector of monthly dummy variables, and u is an error term. The expected number of high-quality contracts in a region with eligible population P is equal to

$$H = \Pi P, \qquad \text{(B.25)}$$

which implies that

$$\log H = \log P + \kappa_X X + \kappa_{RP} R_P + \kappa_{RI} R_I + \kappa_M M + T + u \qquad \text{(B.26)}$$

They assumed T could be eliminated from equation (B.26) by including regional fixed effects in the estimation.

In reduced form, equation (B.26) is closely related to the one estimated by Polich et al. (1986). The major differences in the reduced forms are that Polich et al. (1986) included low-quality enlistment as a regressor and assumed that the coefficient on logP was equal to unity. However, the structural interpretation of the estimated coefficients is quite different. Smith et al. (1990) did not model recruiter preferences, nor did they allow for the possibility of a tradeoff between signing high and low-quality recruits.

### *Other Models*

The models estimated by others are versions of equation (B.20) or equation (B.26). For example, Daula and Smith (1985) estimated a version of equation (B.20) within a switching regression framework to allow for the possibility that some battalions were supply-constrained and others demand-constrained. Warner (1990) estimated versions of equation (B.26) for all four services, augmented to include terms to control for inter-Service competition. Kearl et al. (1990) estimated a version of equation (B.26) for the Army that included the propensity to enlist (from the Youth Attitude Tracking Survey), a variable intended to measure youth's taste for military life. Bohn and Schmitz estimated a linear version of equation (B.26) using data on the Navy.

Which approach is to be preferred? The structural approach developed by Dertouzos (1985) and extended by Berner and Daula (1993) yields estimated coefficients that have a ready theoretic interpretation. Although implementing Berner and Daula's (1993) model is daunting, Dertouzos's model boils down to including low-quality enlistment as a regressor, and is easily implemented provided that data on low-quality enlistment quotas are available to serve as an instrument.[81] It should be noted that the structural parameters in Dertouzos's (1985) model (equation B.16a-d) are scalar multiples of the reduced-form parameters. Thus, estimates of *relative* marginal cost of various policy changes – for example, an increase in recruiter force relative to an increase in advertising – should be insensitive to whether the structural or reduced-form approach is used.[82]

The model of high-quality enlistment supply estimated by this study for the four Services is presented in Chapter 4. The Chapter also includes a discussion of the econometric issues that were addressed, including model specification and estimation procedure. Because data on quotas by quality level were unavailable for all four Services, a reduced-form approach was adopted. As noted previously, this approach assumes that low-quality goals do not appear in equation (B.26).

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[81] Implementing the structural approach may not always be so straightforward. For example, it assumes that the recruiter's utility function (equation B.2 or B.11) is stable over time. Utility, however, is a function of costs of failing to meet one's quota, and the benefits of meeting or exceeding one's quota. These costs and benefits may change, especially over longer periods of time.

[82] This assumes that the bias from excluding low-quality enlistment from the high-quality enlistment supply equation is small.

# Appendix C: Enlistment Supply Regression Results

**Table C.1**
***Step-1 Estimates of Enlistment Supply for Army***

| | *Whole Period* | | *Structural Change* | | *Whole Period* | | *Structural Change* | |
|---|---|---|---|---|---|---|---|---|
| | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat |
| Recruiters | 0.625 | 14.39 | 0.703 | 13.27 | 0.609 | 14.01 | 0.687 | 12.93 |
| x FY9497 | | | -0.247 | -2.67 | | | -0.232 | -2.50 |
| Goal Per Rec | -0.558 | -2.52 | -0.673 | -2.49 | -0.516 | -2.33 | -0.619 | -2.28 |
| x FY9497 | | | 0.495 | 1.05 | | | 0.421 | 0.89 |
| Rec*GPR | -0.084 | -3.01 | -0.103 | -3.02 | -0.079 | -2.83 | -0.096 | -2.82 |
| x FY9497 | | | 0.074 | 1.24 | | | 0.065 | 1.09 |
| Unemployment | 0.260 | 10.16 | 0.223 | 6.77 | 0.250 | 9.67 | 0.230 | 6.96 |
| x FY9497 | | | 0.116 | 2.26 | | | 0.069 | 1.33 |
| Oth Svc HQ Effort | -0.122 | -2.43 | -0.131 | -1.86 | -0.133 | -2.65 | -0.162 | -2.29 |
| x FY9497 | | | 0.000 | 0.01 | | | 0.042 | 0.42 |
| **Army Advertising:** | | | | | | | | |
| Tot Adv last 11 mo | 0.043 | 6.74 | 0.044 | 6.86 | | | | |
| TV Adv last 11 mo | | | | | 0.057 | 3.25 | 0.060 | 3.36 |
| Oth Adv last 11 mo | | | | | 0.085 | 5.35 | 0.086 | 5.44 |
| **Joint Advertising:** | | | | | | | | |
| Tot Adv last 11 mo | -0.011 | -0.44 | -0.005 | -0.21 | | | | |
| TV Adv last 11 mo | | | | | 0.009 | 0.34 | 0.011 | 0.42 |
| Oth Adv last 11 mo | | | | | -0.273 | -4.39 | -0.252 | -4.02 |
| Sample Size | 5188 | | 5188 | | 5188 | | 5188 | |
| Std Error | 0.212 | | 0.211 | | 0.211 | | 0.211 | |
| R-Square | 0.116 | | 0.119 | | 0.122 | | 0.124 | |

**Table C.2**
***Step-1 Estimates of Enlistment Supply for Navy***

| | ***Whole Period*** | | ***Structural Change*** | | ***Whole Period*** | | ***Structural Change*** | |
|---|---|---|---|---|---|---|---|---|
| | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat |
| Recruiters | 0.367 | 7.62 | 0.339 | 5.29 | 0.371 | 7.65 | 0.350 | 5.42 |
| x FY9497 | | | -0.026 | -0.26 | | | -0.043 | -0.42 |
| Goal Per Rec | 1.401 | 5.66 | 0.994 | 3.18 | 1.391 | 5.59 | 0.981 | 3.12 |
| x FY9497 | | | 1.046 | 2.03 | | | 1.067 | 2.07 |
| Rec*GPR | 0.138 | 4.56 | 0.087 | 2.29 | 0.136 | 4.48 | 0.085 | 2.22 |
| x FY9497 | | | 0.133 | 2.12 | | | 0.135 | 2.16 |
| Unemployment | 0.292 | 10.37 | 0.256 | 7.21 | 0.287 | 10.16 | 0.248 | 6.93 |
| x FY9497 | | | 0.092 | 1.59 | -0.134 | -2.64 | 0.103 | 1.77 |
| Oth Svc HQ Effort | -0.132 | -2.59 | -0.128 | -1.90 | | | -0.128 | -1.90 |
| x FY9497 | | | -0.017 | -0.17 | | | -0.024 | -0.24 |
| **Navy Advertising:** | | | | | | | | |
| Tot Adv last 11 mo | 0.086 | 2.22 | 0.075 | 1.93 | | | | |
| TV Adv last 11 mo | | | | | 0.111 | 2.28 | 0.092 | 1.88 |
| Oth Adv last 11 mo | | | | | 0.107 | 1.34 | 0.109 | 1.37 |
| **Joint Advertising:** | | | | | | | | |
| Tot Adv last 11 mo | 0.000 | -0.01 | 0.015 | 0.51 | | | | |
| TV Adv last 11 mo | | | | | -0.021 | -0.69 | -0.005 | -0.16 |
| Oth Adv last 11 mo | | | | | 0.136 | 1.86 | 0.145 | 1.97 |
| Sample Size | 5185 | | 5185 | | 5184 | | 5185 | |
| Std Error | 0.248 | | 0.248 | | 0.248 | | 0.248 | |
| R-Square | 0.121 | | 0.124 | | 0.122 | | 0.125 | |

**Table C.3**
***Step-1 Estimates of Enlistment Supply for Air Force***

| | ***Whole Period*** | | ***Structural Change*** | | ***Whole Period*** | | ***Structural Change*** | |
|---|---|---|---|---|---|---|---|---|
| | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat |
| Recruiters | 0.307 | 5.81 | 0.251 | 3.58 | 0.307 | 5.77 | 0.251 | 3.56 |
| x FY9497 | | | 0.113 | 0.99 | | | 0.112 | 0.99 |
| Goal Per Rec | 0.450 | 2.72 | 0.144 | 0.60 | 0.449 | 2.70 | 0.143 | 0.60 |
| x FY9497 | | | 0.459 | 1.28 | | | 0.463 | 1.28 |
| Rec*GPR | 0.032 | 1.89 | 0.003 | 0.12 | 0.032 | 1.87 | 0.003 | 0.12 |
| x FY9497 | | | 0.043 | 1.14 | | | 0.043 | 1.15 |
| Unemployment | 0.226 | 7.78 | 0.186 | 5.03 | 0.226 | 7.77 | 0.187 | 5.02 |
| x FY9497 | | | 0.087 | 1.47 | | | 0.086 | 1.46 |
| Oth Svc HQ Effort | -0.078 | -1.37 | -0.073 | -0.96 | -0.078 | -1.37 | -0.073 | -0.95 |
| x FY9497 | | | 0.006 | 0.06 | | | 0.007 | 0.06 |
| **AF Advertising:** | | | | | | | | |
| Oth Adv last 11 mo | -0.095 | -0.87 | -0.074 | -0.68 | -0.095 | -0.87 | -0.075 | -0.69 |
| **Joint Advertising:** | | | | | | | | |
| Tot Adv last 11 mo | 0.040 | 1.36 | 0.038 | 1.26 | | | | |
| TV Adv last 11 mo | | | | | 0.040 | 1.30 | 0.039 | 1.25 |
| Oth Adv last 11 mo | | | | | 0.045 | 0.58 | 0.029 | 0.38 |
| | | | | | | | | |
| Sample Size | 5171 | | 5171 | | | 5171 | 5171 | |
| Std Error | 0.258 | | 0.257 | | | 0.257 | 0.257 | |
| R-Square | 0.051 | | 0.054 | | | 0.051 | 0.054 | |

**Table C.4**
***Step-1 Estimates of Enlistment Supply for Marine Corps***

| | ***Whole Period*** | | ***Structural Change*** | | ***Whole Period*** | | ***Structural Change*** | |
|---|---|---|---|---|---|---|---|---|
| | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat | Coeff. | T-Stat |
| Recruiters | 0.433 | 10.27 | 0.415 | 9.31 | 0.424 | 10.01 | 0.404 | 9.02 |
| x FY9497 | | | 0.052 | 1.29 | | | 0.056 | 1.39 |
| Goal Per Rec | 0.038 | 2.07 | -0.028 | -1.09 | 0.041 | 2.24 | -0.023 | -0.91 |
| x FY9497 | | | 0.132 | 3.62 | | | 0.128 | 3.52 |
| Rec*GPR | 0.000 | 0.37 | 0.000 | -0.39 | 0.000 | 0.32 | 0.000 | -0.82 |
| x FY9497 | | | 0.000 | 0.87 | | | 0.000 | 1.42 |
| Unemployment | 0.284 | 9.26 | 0.279 | 7.21 | 0.288 | 9.37 | 0.290 | 7.45 |
| x FY9497 | | | 0.020 | 0.32 | | | 0.007 | 0.11 |
| Oth Svc HQ Effort | -0.274 | -4.40 | -0.317 | -3.82 | -0.257 | -4.11 | -0.302 | -3.63 |
| x FY9497 | | | 0.141 | 1.11 | | | 0.147 | 1.16 |
| **MC Advertising:** | | | | | | | | |
| TV Adv last 11 mo | -0.212 | -2.74 | -0.212 | -2.63 | -0.239 | -3.07 | -0.228 | -2.82 |
| **Joint Advertising:** | | | | | | | | |
| Tot Adv last 11 mo | 0.042 | 1.30 | 0.041 | 1.27 | | | | |
| TV Adv last 11 mo | | | | | 0.068 | 2.00 | 0.069 | 2.02 |
| Oth Adv last 11 mo | | | | | -0.161 | -1.94 | -0.180 | -2.12 |
| Sample Size | 5145 | | 5145 | | 5145 | | 5145 | |
| Std Error | 0.279 | | 0.279 | | 0.279 | | 0.279 | |
| R-Square | 0.042 | | 0.045 | | 0.044 | | 0.047 | |

**Table C.5**
***Step-2 Estimates of Enlistment Supply for Army and Navy***

| | *Army* | | | | *Navy* | | | |
|---|---|---|---|---|---|---|---|---|
| | ***Coeff.*** | ***T-Stat*** | ***Coeff.*** | ***T-Stat*** | ***Coeff.*** | ***T-Stat*** | ***Coeff.*** | ***T-Stat*** |
| Intercept | -6.882 | -14.50 | -11.011 | -9.56 | -6.931 | -13.15 | -9.008 | -7.58 |
| Log Rel Pay | 1.045 | 11.07 | 1.045 | 11.09 | 1.173 | 11.25 | 1.172 | 11.24 |
| Pct Elig for CF | 0.327 | 3.79 | | | 0.184 | 1.98 | | |
| PV of CF | | | 0.471 | 3.82 | | | 0.230 | 2.00 |
| x May-Sep 97 | | | -0.020 | -4.59 | | | | |
| Log Exp Bonus | 0.122 | 5.87 | 0.141 | 6.59 | 0.024 | 1.00 | 0.031 | 1.24 |
| Log Pct Veteran | 1.442 | 28.42 | 1.442 | 28.44 | 1.475 | 26.32 | 1.475 | 26.31 |
| Pop Density | -0.001 | -16.88 | -0.001 | -16.88 | -0.002 | -26.24 | -0.002 | -26.23 |
| Black | 0.488 | 4.15 | 0.486 | 4.14 | 1.473 | 11.35 | 1.472 | 11.34 |
| Hispanic | 0.569 | 7.26 | 0.569 | 7.26 | 1.424 | 16.43 | 1.424 | 16.43 |
| Log Pct QMA | 0.423 | 2.19 | 0.420 | 2.17 | 1.774 | 8.29 | 1.773 | 8.29 |
| Log Pct Coll | -0.869 | -8.57 | -0.871 | -8.59 | -1.010 | -9.02 | -1.010 | -9.01 |
| Log Fam Inc | -0.724 | -16.92 | -0.723 | -16.91 | -0.784 | -16.56 | -0.784 | -16.57 |
| October | 0.107 | 4.89 | 0.104 | 4.78 | 0.072 | 2.83 | 0.073 | 2.86 |
| November | 0.014 | 0.64 | 0.014 | 0.63 | 0.019 | 0.77 | 0.020 | 0.81 |
| December | 0.116 | 5.33 | 0.108 | 4.92 | 0.215 | 8.97 | 0.214 | 8.92 |
| January | 0.054 | 2.55 | 0.045 | 2.11 | 0.119 | 5.03 | 0.117 | 4.95 |
| February | 0.076 | 3.51 | 0.065 | 2.95 | 0.154 | 6.51 | 0.152 | 6.43 |
| March | -0.066 | -3.03 | -0.064 | -2.95 | 0.046 | 1.95 | 0.043 | 1.82 |
| April | -0.131 | -5.85 | -0.132 | -5.89 | -0.025 | -1.09 | -0.028 | -1.18 |
| May | 0.136 | 6.16 | 0.135 | 6.13 | 0.275 | 11.71 | 0.275 | 11.69 |
| June | 0.150 | 6.85 | 0.150 | 6.83 | 0.284 | 12.08 | 0.284 | 12.03 |
| July | 0.184 | 8.41 | 0.183 | 8.37 | 0.270 | 11.46 | 0.268 | 11.34 |
| August | 0.111 | 5.21 | 0.112 | 5.23 | 0.111 | 4.68 | 0.109 | 4.61 |
| FY 1990 | 0.093 | 3.69 | 0.130 | 6.04 | 0.132 | 6.31 | 0.139 | 6.81 |
| FY 1991 | 0.022 | 1.00 | 0.099 | 4.18 | 0.100 | 4.94 | 0.111 | 5.61 |
| FY 1992 | -0.067 | -2.29 | 0.031 | 1.02 | 0.076 | 3.20 | 0.099 | 3.83 |
| FY 1993 | -0.138 | -7.21 | -0.125 | -6.56 | -0.091 | -2.92 | -0.117 | -3.42 |
| FY 1994 | -0.201 | -10.12 | -0.172 | -7.88 | -0.222 | -6.46 | -0.246 | -6.30 |
| FY 1995 | -0.186 | -9.94 | -0.142 | -6.71 | -0.318 | -8.69 | -0.332 | -7.84 |
| FY 1996 | -0.162 | -8.22 | -0.092 | -3.86 | -0.278 | -7.61 | -0.289 | -7.13 |
| FY 1997 | -0.230 | -9.81 | -0.083 | -2.03 | -0.354 | -8.70 | -0.352 | -8.86 |
| Sample Size | 5188 | | 5188 | | 5185 | | 5185 | |
| Std Error | 0.297 | | 0.297 | | 0.328 | | 0.328 | |
| R-Square | 0.561 | | 0.562 | | 0.576 | | 0.576 | |

**Table C.6**
***Step-2 Estimates of Enlistment Supply for Air Force and Marine Corps***

| | *Air Force* | | *Marine Corps* | |
|---|---|---|---|---|
| | ***Coeff.*** | ***T-Stat*** | ***Coeff.*** | ***T-Stat*** |
| Intercept | -5.880 | -11.97 | -9.030 | -16.75 |
| Log Rel Pay | 0.666 | 6.53 | 0.383 | 3.43 |
| Log Pct Veteran | 0.971 | 17.72 | 1.097 | 18.21 |
| Pop Density | -0.001 | -15.37 | -0.002 | -16.11 |
| Black | -0.186 | -1.46 | 0.325 | 2.34 |
| Hispanic | 0.370 | 4.37 | 0.518 | 5.57 |
| Log Pct QMA | 0.276 | 1.32 | 0.187 | 0.82 |
| Log Pct Coll | -1.172 | -10.70 | -0.893 | -7.43 |
| Log Fam Inc | -0.624 | -13.50 | -0.401 | -7.89 |
| October | -0.058 | -2.45 | 0.045 | 1.73 |
| November | -0.104 | -4.40 | -0.014 | -0.54 |
| December | 0.138 | 5.86 | 0.144 | 5.62 |
| January | 0.113 | 4.94 | 0.022 | 0.86 |
| February | 0.182 | 7.96 | 0.043 | 1.72 |
| March | 0.048 | 2.11 | -0.113 | -4.52 |
| April | -0.031 | -1.34 | -0.117 | -4.65 |
| May | 0.077 | 3.38 | 0.329 | 13.11 |
| June | 0.195 | 8.51 | 0.308 | 12.28 |
| July | 0.337 | 14.72 | 0.244 | 9.71 |
| August | 0.166 | 7.25 | 0.082 | 3.27 |
| FY 1990 | -0.133 | -6.75 | 0.132 | 6.12 |
| FY 1991 | -0.220 | -11.65 | 0.122 | 5.87 |
| FY 1992 | -0.178 | -9.29 | 0.109 | 5.18 |
| FY 1993 | -0.265 | -13.41 | 0.138 | 6.37 |
| FY 1994 | -0.238 | -11.98 | 0.144 | 6.62 |
| FY 1995 | -0.217 | -10.86 | 0.103 | 4.68 |
| FY 1996 | -0.153 | -7.56 | 0.192 | 8.64 |
| FY 1997 | -0.232 | -10.57 | 0.217 | 9.01 |
| Sample Size | 5171 | | 5155 | |
| | 0.320 | | 0.351 | |
| | 0.497 | | 0.376 | |

## Appendix D: Military Advertising

***Theory***. Dertouzos and Garber (1999a) noted that two key issues in estimating the effects of advertising are (1) functional form - the shape of the relationship between expenditures or impressions and enlistments; (2) dynamics - how advertising in one period affects recruiting in subsequent periods. A general model of the effects of advertising can be written as:

$$Y_{s,t} = Z_{s,t}\beta + \Sigma_{j=1,3}\Sigma_{0,\infty}\ w_{j,k,t-k} f_j(a_{j,s,t-k}) + v_{s,t} \quad (5.7)$$

where $j$ represents advertising media (TV, radio, or print), and $t$ and $k$ represent time periods. The variable $a_{j,s,t}$ denotes expenditure on media $j$ in state s at time $t$, and $f_j$ is a medium-specific function. The $w_{j,t-k}$ are weights to be estimated from the data.

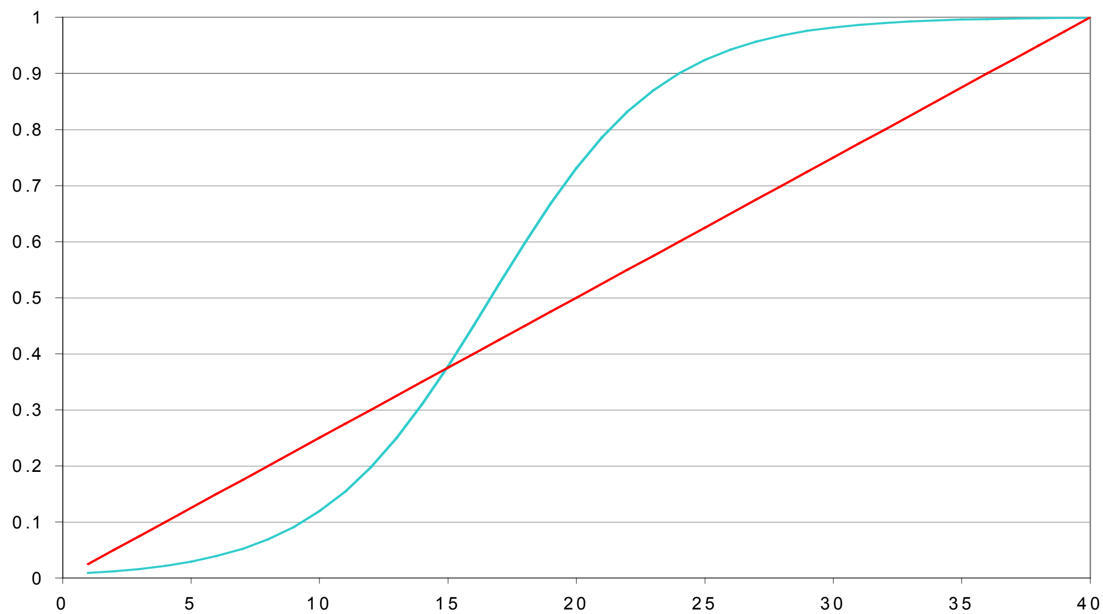
Researchers frequently specify $f_j(a_{j,s,t}) = \ln(a_{j,s,t})$. However, use of the logarithmic transformation requires excluding those observations for which $a_{j,s,t} = 0$, often the case with military advertising.[83] More importantly, however, a logarithmic specification imposes a constant elasticity assumption regardless of the level of advertising expenditures. Dertouzos and Garber argue that this functional relationship needs to be flexible in order to estimate the effects of large changes in advertising program budgets. Furthermore, the specific form should be determined by analysis of the data rather than imposed *a priori*.

A function that meets these criteria is the Box Cox function, defined by $f_j(a_{j,s,t}) = (a_{j,s,t}^{\lambda} - 1) / \lambda$, where $\lambda$ is a parameter to be estimated. When $\lambda = 1$, $f_j(a_j) = a_j$; when $\lambda = 0$, $f_j(a_j) = \ln(a_j)$. When $0 < \lambda < 1$, the shape of $f_j$ is between the shapes of the linear and logarithmic functions. The parameter $\lambda$ is estimated along with the other parameters of the model. Although more flexible than many alternatives, the Box Cox function imposes diminishing marginal productivity of advertising. A function that allows regions of both increasing and diminishing returns is the logistic function, given by: $f_j(a_{j,s,t}) = 1 / [1 + \exp(5 - \beta a_{j,s,t})]$. Here, $\beta$ is a parameter to be estimated. The region of increasing returns is smaller the larger the value of $\beta$.[84]

Figure D.1 shows examples of logistic and linear relationships between the log of high-quality enlistments and advertising expenditures. Compared with the linear relationship, the S-shaped logistic function is characterized by first a region of increasing returns, followed by a region of diminishing returns. The Box-Cox relationship would take the form of an inverted U-shaped curve for values of $0 \leq \lambda < 1$, and would be linear in the case $\lambda = 1$.

[83] Alternatively, one can set $a_{jt}$ equal to some small number. However, Hogan et al. (1996) reported that results were sensitive to this choice of number. For this reason, they entered advertising linearly in levels, so $f_{jt} = a_{jt}$.
[84] The logistic function restricts the region of increasing returns to occur at smaller values of $a_{jt}$, but this is consistent with the restrictions imposed by economic theory.

**Figure D.1**
***Hypothetical Relationships between Log of High-Quality Enlistment and Advertising: Logistic and Linear Case***



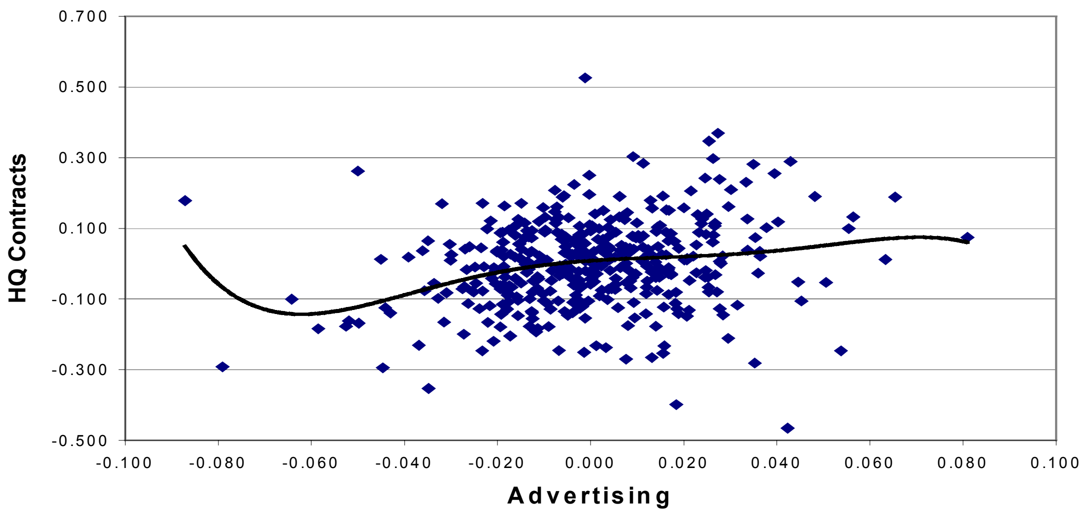

In order to select a relationship that best describes the effects of advertising for this study, an evaluation of the linear, logistic, and Box-Cox transformations was undertaken using Navy data.[85] The logistic transformation fit the data slightly better than the linear or Box-Cox transformations. However, the procedure for fitting the model to the data required searching over all possible values of $\beta$ to find the "best" value.

At the same time, there appeared to be little information lost when the simpler linear transformation of advertising expenditures was used in the supply models.[86] Figure D.2 demonstrates this conclusion. It shows plots of annual averages of the log of Army high-quality contracts versus Army total advertising expenditures (cents per youth), by state.[87] Both series were normalized so their respective means equal zero.[88] A nonlinear fifth-order polynomial function was fit through the data points. Although this function is nonlinear and very flexible, the largest segment of the fitted line in Figure D.2 is clearly linear. Moreover, the parts of the relationship that are nonlinear correspond to unusually low and extremely high levels of advertising expenditures. Figure D.2 shows that there were very few such observations in the database. This analysis suggested that the additional value of the information provided by a non-linear advertising function did not justify the addition to cost required to fit such relationships in

[85] Complete advertising data for the Army were unavailable at the time of the analysis.
[86] The linear and logistic models yielded nearly identical estimates of the sensitivity of high-quality enlistments to advertising, evaluated at the sample means of the data. F- and t- test statistics were also similar.
[87] That is, each point in Figure 5.2 represents a state in a given year.
[88] The Army spent an average of 29 cents per month per youth on advertising over the period FY89-97.

this study. A simpler linear relationship between advertising expenditures and enlistments was included in the enlistment supply functions estimated in this study.[89]

**Figure D.2**
***Army High-Quality Contracts Versus Total Army Advertising (Normalized)***




The second important specification raised by Dertouzos and Garber is the timing of the relationship between advertising and enlistment. Advertising in a particular month is likely to affect high-quality enlistment in future months, and the econometric problem is how to specify the timing of the advertising-enlistment relationship. Some studies have imposed specific distributed lag relationships. One popular form of distributed lag relationship, the Koyck lag, imposes a geometrically declining relationship between advertising today and enlistments in the future. That is, advertising has a larger near term effect than far term effect. Specific forms of relationship such as the Koyck run the risk that the true relationship is not of the assumed form.

[89] The emphasis of this study was in finding broad patterns in the data rather than in finding the most accurate fit between enlistments and advertising.

| REPORT DOCUMENTATION PAGE | *Form Approved* *OMB No. 0704-0188* |
|---|---|



**1. REPORT DATE** *(DD-MM-YYYY)*: April, 2001

**2. REPORT TYPE**: Technical report

**3. DATES COVERED** *(From - To)*: 1987-1997

**4. TITLE AND SUBTITLE**

Enlistment Supply in the 1990s: A Study of the Navy College Fund and Other Enlistment Incentive Programs.

**5a. CONTRACT NUMBER**

DAS W01-94-C-0125/
DAS W01-97-C-0076

**5b. GRANT NUMBER**

**5c. PROGRAM ELEMENT NUMBER**

**6. AUTHOR(S)**

John T. Warner, (Clemson University), Curtis J. Simon, (Clemson University), Deborah M. Payne, (Anderson College), and J. Michael Jones (Graduate Student, Clemson University)

**5d. PROJECT NUMBER**

**5e. TASK NUMBER**

**5f. WORK UNIT NUMBER**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**

**8. PERFORMING ORGANIZATION REPORT NUMBER**

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

Defense Manpower Data Center
1600 Wilson Blvd., Suite 400
Arlington, VA 22209-2593

**10. SPONSOR/MONITOR'S ACRONYM(S)**

**11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

2000-015

**12. DISTRIBUTION/AVAILABILITY STATEMENT**

Approved for public release; distribution is unlimited.

**13. SUPPLEMENTARY NOTES**

**14. ABSTRACT**

The Office of the Undersecretary of Defense for Personnel and Readiness [OUSD(P&R)] authorized an expansion of the Navy College Fund (NCF) program in FY94 from 2,000 to 10,000 recruits to support the Navy's'recruiting mission. At the request of OUSD(P&R), the Defense Manpower Data Center (DMDC) undertook an evaluation study of the effectiveness of the expanded NCF program. A research team at Clemson University conducted the study for DMDC. Topics addressed in the study include: the impact of the expansion of the NCF and other enlistment incentives on Navy high quality enlistments, other recruiting outcomes such as attrition from the Delayed Entry Program (DEP), other Service recruiting program outcomes, and cost-effectiveness issues. Highlights of the report include: a) both the NCF and Army College Fund (ACF) expand high-quality enlistments; b) the NCF and ACF affect other recruiting program outcomes, such as DEP attrition; c) the NCF and ACF are cost-effective programs; d) reductions in unemployment, increases in the college population and decreases in the veterans population over time explain much of recent recruiting difficulties. The study also estimated the recruiting effects of military pay, enlistment bonuses, recruiters and advertising, and analyzed the role of propensity.

**15. SUBJECT TERMS**

High quality enlistments, Delayed Entry Program (DEP), DEP attrition, recruiting mission, enlistment incentives, Navy College Fund (NCF), Army College Fund (ACF), enlistment bonuses, wages, unemployment, population, college enrollment, veterans, population.

| 16. SECURITY CLASSIFICATION OF: a. REPORT | b. ABSTRACT | c. THIS PAGE | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
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| U | U | U | UL | 106 | Dr. Robert W. Tinney |
| | | | | | **19b. TELEPHONE NUMBER** *(Include area code)* 703-696-6765 |

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